Electrical World

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Crossing an Invisible Line

AN invisible line divides December 31, 1915, from January 1, 1916. On one side of the line a nation of men and thousands of industries momentarily halt and check up what they have done for the year past; on the other side they determine on their future course and start forward. Custom has developed a national habit. As individuals we "turn over a new leaf" on the first day of January and make our individual resolutions. As industries we total and inventory what we have done and make plans and set quotas of what we want to accomplish. The electrical industry as a whole is characterized by the same tone as all business. As engineers, as manufacturers, as central-station managers, as men whose business is the sale and distribution of electrical goods, we are figuring how we can reduce the costs of our business as indicated by the past year's totals and how we can extend the amount of our business as indicated by the conditions ahead. These conditions for 1916 look most favorable. The central-station industry as a whole has prospered and is in position to extend again. Consumers of electrical materials and goods have money with which to buy. Outside the immediate electrical market the country as a whole is in good condition. Preparedness for national defense seems assured, and the development in which an active program will result means an increase in the interchange of the products of labor and capital, with a consequent gain in activity in many lines of industry directly or indirectly interwoven in the whole fabric of American commerce. No time has seemed more favorable for the intensive cultivation of our home markets and for the extension of our foreign trade.

Central-Station Power for Steam Railways

RECENT practice in railroad electrification needs to be interpreted with broad financial considerations in mind, as well as from the engineering viewpoint. The question as to whether a steam railway shall make its own power or shall purchase it from central stations is not alone a problem of relative cost of power but also a question as to whether investment in even a most efficient power plant is the most profitable use to which the railroad can put its money. Consideration of the two latest electrification projects, one on the Pennsylvania Railroad and the other on the New York, New Haven & Hartford Railroad, for which it has been decided to purchase power rather than make it, brings the capital factor to the front. A railroad is in the transportation business, a central station is in the power-generation business. It is assumed that each can make the best use of its capital by sticking to its own last. The railroad can put its money into operating the railroad and keep it busy there; the central station in its turn can focus its energies not only on producing power at lowest cost but on adjusting its charges for the power so produced on the basis of how and when it is used. A railroad by law can manufacture energy only for itself. While its requirements are favorable to technically efficient electric-power generation, it has not the chance to dispose of all the power so produced on the same basis as a central station. The central station, on the other hand, can take this favorable load at a cost to the railroad which in many cases is as low as the railroad can produce power itself, leaving aside the capital considerations already touched upon. The next natural question is this: Would railroads now operating power plants be justified in bargaining with the local central-station companies to sell the railroad power plants to those companies, which in turn could tie in the plants with their other units and render even better service to the railroad and the community at large?

Business Asks Help

BUSINESS asks the help of the Federal Trade Commission. If this need is not met by constructive aid, the public will wonder why the commission exists. No government agency has a larger opportunity than this one to create precedents and conditions that will make the path of the business man clearer. It is encouraging to learn that the commission and the Department of Justice are considering means of co-operating to avoid duplication of work and to render systematic service. The old conception of the government function was that of a body that remained inert and dignified in its silence until a case had been woven about a sometimes innocent violator of the statutes. What business seeks is friendly advice. If customary trade practices are inhibited, that fact should be made as plain as possible. Then it will be easier both for merchants and manufacturers to obey the law and for the government to enforce the law. An ounce of prevention is still worth a pound of cure. When business men understand fully what they ought not to do they will know better what they can do. And unity of thought and action between commerce and government are necessary for the larger international policies of the future.

How Development Charges May Limit Advance

ONE consideration sometimes overlooked in the development of a new application of electricity for a sister art or industry is the ratio of engineering development charges to total costs to make and sell. It is a

fact that the engineering costs of a new project may eat up not only the profit on that particular undertaking but the expectation of profit on future business of the same sort. Profits in an engineering manufacturing concern such as an electrical business accrue only when the market for new apparatus is big enough to absorb the devices or machines in quantity. If the large quantity can be built, the primary development charges can be proportioned to a number of orders and so a fair profit on each can be taken. Always the maker takes a certain risk, particularly if the immediate larger market is not in sight. New uses for electricity are now being found in industrial heating. As is often the case at the start, many of these first applications are individual and special. Few standards have been developed. The development charges in each such case must equal the price which can be asked, and the manufacturer finds little incentive to get the business. The future market in electric heating should not be underestimated. Development charges are usually in proportion to the size of the manufacturing company. Overhead items are lower for the smaller manufacturer, and he is often in a position to exercise his ingenuity more flexibly than the larger and slower-moving organization. New developments consequently offer an especial opportunity for the small manufacturer. On the other hand, if a future market is assured, the large manufacturer can afford to absorb excessive development charges in other ways and so help promote the new development.

Errors with the Use of Instrument Transformers

ONE of the greatest triumphs of electrical engineering has been the transmission of power over great distances. This vanquishing of distance has come about through the use of high voltages and through learning how to generate and control high voltages together with powerful currents.

One of the commissions which the engineer must pay for the privilege of using high voltage and powerful alternating currents is that in making measurements on such circuits of voltage current or power instrument transformers must be used. It becomes inconvenient and expensive to employ voltmeters of high pressure and ammeters of large range. It becomes distinctly advantageous to use step-down transformers of voltage and current so as to enable ordinary low-range voltmeters and ammeters to be used. These intermediate devices, or instrument transformers, are, however, subject to difficulties and inaccuracies of their own.

As is clearly pointed out in the article upon the subject by R. H. Chadwick on page 1308, the use of an instrument transformer with either a voltmeter or an ammeter ordinarily involves no new error except that of ratio in the instrument transformer, so that if this ratio has, say, 2 per cent error the reading of the voltmeter or ammeter connected with it will be affected to like degree. The corresponding correction is both simple and evident. But when the instrument is a wattmeter it is well known that a new source of error opens up, namely, phase-coincidence imperfection. The duty of the instrument transformer, when connected to line, is to provide the reduced amount of voltage or current at secondary or instrument terminals in exactly opposite phase to that taken at primary terminals. It is not easy to obtain exactly this opposition in phase at all loads. It is usually not difficult to secure exact phase opposition at some particular load, and then to accept a certain small range of phase error under departures from this load.

It might readily be supposed, at first sight, that a small deviation in phase opposition supplied by an instrument transformer, amounting, say, to one degree of arc, would not be serious, and, indeed, as the article shows, it is very small if the power-factor of the circuit on which the power is measured happens to be almost 100 per cent. If, however, the power-factor of the circuit is rather low, say 50 per cent, the error due to one degree of departure from phase opposition may be 3 per cent. With yet lower power-factors the error will rapidly increase.

With the aid of the tables and diagrams accompanying the paper, it becomes readily possible to determine the percentage error in a wattmeter reading which a known phase-angle deviation in an instrument transformer can effect at any given power-factor of the load circuit. It is shown that it follows very nearly a straight law, with ordinary small phase deviations.

What a Generating Station Costs

UNUSUALLY complete construction costs for a moderate-sized generating station are found elsewhere in this issue. These data show the actual expense and the unit-cost basis of all the essential items for a turbine installation which, although not new, has been equipped and maintained with efficient apparatus arranged to operate according to the best modern practice. While the figures cannot be taken as universal standards in any sense, they may be considered authoritative within their range of application under similar conditions and hence are useful for comparison. The nature of the information should suggest the compilation of similar data and their frequent publication. After all, there is nothing so sacred about cost data as to justify those who possess them in stowing them away in a strong-box. The industry needs information of this character quite as much as records of station performance because of the influence total investment has on yearly maintenance and extensions. It should be pointed out in this connection that the time will come when more attention will be given to the separation of labor and material charges and the presentation of data to show the relationship according to some definite basis. While the number of variables entering into construction costs may in many cases be large, complete records at the time of the installation, analyzed by one familiar with the construction methods used, help in the formulation of unit costs for different station designs as well as in the detection of special charges due to particular conditions. Such completeness is vital if conclusions from cost data are to serve a useful purpose.

The Naming of Electrical Appliances

IF you will recall the circumstances attending your own purchases during the last half year, you will remember that in the hat store you were not particularly attracted to the first few specimens shown by the salesman. But presently, when he brought out a hat saying that its color was a new one known as "Exposition" gray, you were attracted and you bought. Perhaps in selecting the goods for your last suit you were in doubt until your tailor referred to a certain piece as "California weight, good for both winter and summer year." If you happen to have recently observed a couple of "newly-weds," you know how their eyes sparkled at the mention of "Colonial" silver. And so it goes. The ordinary goods of staple lines are sold by attractive adjectives coined or adopted by nimble-minded salesmen and advertising men. In the electrical industry the products are named, it seems, by men who think of a name merely as a designation and not as a sales vehicle. For the good of the industry, it has been suggested, a change should be made in selecting names, especially for domestic appliances.

Metallurgical and Electrical Engineering

AS the engineer depends upon the metallurgist for many very important materials of construction, any progress in metallurgy is sure to affect some phase of engineering. When electrolytic copper refining was invented some thirty years ago, the simple fact that the gold and silver could be easily recovered from the anode slimes made it at once a metallurgical success; but the further fact that the purified cathode copper has an electric conductivity very much better (apparently out of all proportion better) than the somewhat less pure anode copper gave a greatly enhanced value to the metallurgical process and made it even more important from the standpoint of the electrical engineer. It is not too much to say that without electrolytic copper refining the evolution of modern electrical engineering would have been impossible. This is the classical example of the interrelation between electrical engineering and metallurgy. To mention only a few other debts of electrical engineering to metallurgy, one may refer to the interesting parallelism between metallurgical research on rare metals and the researches on incandescent lamps which yielded in rapid succession the osmium, tantalum and tungsten lamps. Electroplating with cobalt is one of the latest contributions of the electrometallurgist, as explained elsewhere in this issue. Without such metallurgical research modern high-speed tool steels would have been impossible.

Protection by Outdoor Fuses

OUTDOOR fuses are being used a great deal between customers' transformer substations and the transmission lines of operating companies. As pointed out in an article elsewhere in this issue, some form of fuse is at present the most available means of disconnecting the customer in case of trouble, largely because the cost of oil switches or any other form of automatic disconnection now available is much higher. Since a fuse is the only means of protection which is both satisfactory and cheap, the question of suitable designs for outdoor switching is a very live one. There is some difference of opinion as to the purpose of high-tension fuses. With some operating companies it is the practice to install fuses of such a size that they will protect the transformer bank against excessive load. Other companies use fuses of such size that they will not blow except in cases of short-circuit in the transformers or on their main secondaries. The practice of one large operating company is to install fuses which will not blow at less than four times the full load on the transformer bank. The purpose of the fuse in this case is to disconnect the transformer bank from the line so that the service to other customers will not be affected. The fuse therefore offers only partial protection to the transformer bank. Further protection must be furnished by fuses or circuit-breakers in the secondary circuits. Since transformer banks are usually scattered over a large territory, heavy fusing of this character has been found essential to prevent a large number of long-time interruptions to customers which might occur if the transformers were fused in accordance with the other scheme referred to.

Extensive tests of various metals and alloys to determine which is most suitable for outdoor fuses have shown that some metals and alloys slowly oxidize after the fuse has been raised to a red heat several times. This action reduces the cross-section of the fuse and makes it blow on normal load. Other alloys have been found to form a hard, infusable crust on the surface under the same conditions. This crust takes the form of a tube which allows the alloy inside to become melted but holds it in position until the core vaporizes. Some such alloys require a higher current to fuse after the crust has been formed than when they are new. Copper, therefore, seems to be thus far the best available fuse metal to use for the reasons pointed out by the author. As mentioned by Mr. Dillard also, it is now recognized that the horn-gap fuse is not entirely satisfactory, and results of experience such as he gives in developing a better type of fuse are therefore valuable.

Editorial Announcement

IN this issue, the second of the month, emphasis is laid on engineering features of operating practice. Last week public-relation topics were emphasized. Next week, in the third issue of the month, which is regularly devoted to engineering and scientific advance, will appear articles on the analysis of vibrations caused by the operation of steam turbines and on the technical work of the National Bureau of Standards. The fourth issue of the month, following the usual plan, will be given over largely to subjects of commercial practice in the industry, including an article on the easy-payment plan of selling domestic electrical appliances, presenting the experience of a manufacturer who has used this plan in the conduct of his business with a large measure of success.

Fifteen Hundred Texas Farmers Guests of Waco Merchants at Electrical Prosperity Dinner

Wherever Electrical Prosperity Week was celebrated to any degree the co-operation of the local business interests other than electrical was assured. Business men's leagues were prominent on many of the local committees. The picture printed on the left shows 1500 farmers entertained at an open-air banquet as a part of the Waco (Tex.) Electrical Prosperity Week celebration. The banquet was held under the auspices of the Young Men's Business League of Waco on Tuesday evening, Nov. 30. The Texas Power & Light Company furnished the illumination for the evening.

A Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

SUCCESS MARKS PROSPERITY WEEK

Reports from Far and Wide Are Enthusiastic in Praise of Nation-Wide Sales Campaign

The phenomenal success of the nation-wide celebration of Electrical Prosperity Week is evident from the reports that are streaming in from all parts of the country. Central stations, manufacturers, jobbers, dealers, contractors, and even the telephone companies—all utilized the spirit of the week in promoting new business. As a forerunner to the Christmas sales campaign it met with unqualified success, some companies even reporting that all of the stock that had been laid in for Christmas was disposed of early in the week. For its part in the nation's education the week was also very valuable, since in many cities the school children heard instructive addresses on electricity or competed for prizes offered for the best essays on uses of electricity close to the home life.

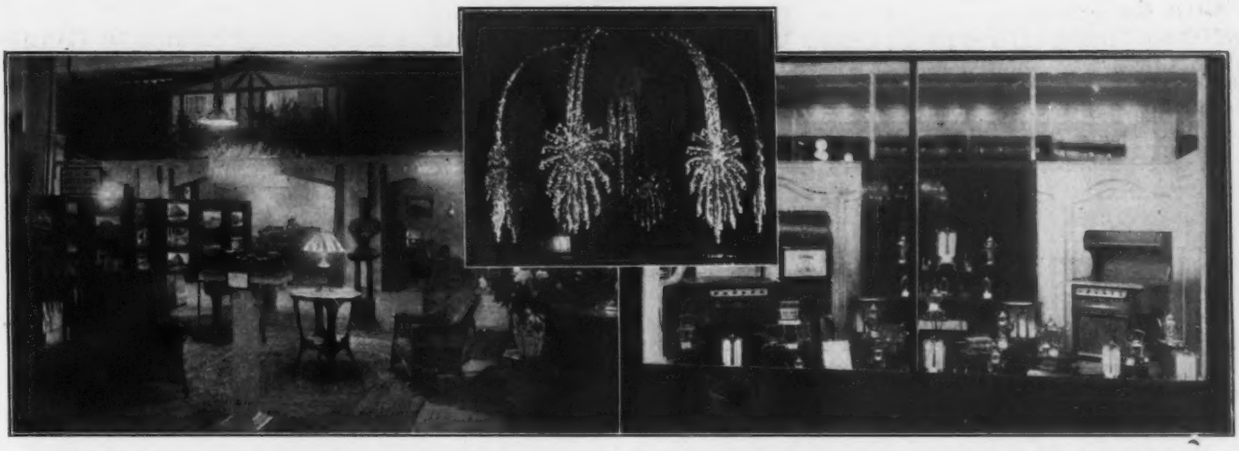
The celebration activities were not limited to the electrical interests, but in most places local commercial clubs, and even the city fathers, were enlisted in active co-operation.

Public interest was stimulated in an almost unlimited number of ways. The more general plans included one or more of the following: Electric show, special illumination of city and public buildings, special-appliance and house-wiring sales, illuminated parades, essays by school children, electrical "movies," special electrical editions of local papers, and lectures before local meetings of non-electrical interests.

In Philadelphia all the preliminary work was handled by a committee of the Philadelphia Electric Company's employees. The big commercial point of the campaign was the offer of an allowance of $1 per energy-consuming outlet on the cost of wiring any already-built house or store along existing lines. This allowance, which was borne entirely by the company, the contractor charging his regular prices in the estimate, amounted to practically a 20 per cent saving on the cost of wiring.

The electrical interests in the city constructed about fifteen floats, all of them electrically illuminated and most of them quite elaborate in character. A schedule was arranged so that to each of the several business districts one night was given upon which this electrical parade traversed its principal business streets. This created a great deal of enthusiasm, and the business men in each district co-operated by entering from 75 to 150 floats, decorated trucks and delivery wagons, automobiles, etc., in these nightly parades. In one

A PARADE OF ELECTRIC-LIGHTED FLOATS DURING PHILADELPHIA'S CELEBRATION OF PROSPERITY WEEK. THE HOUSE-WIRING FLOAT AT THE LEFT CONTAINED A MOTION-PICTURE OUTFIT

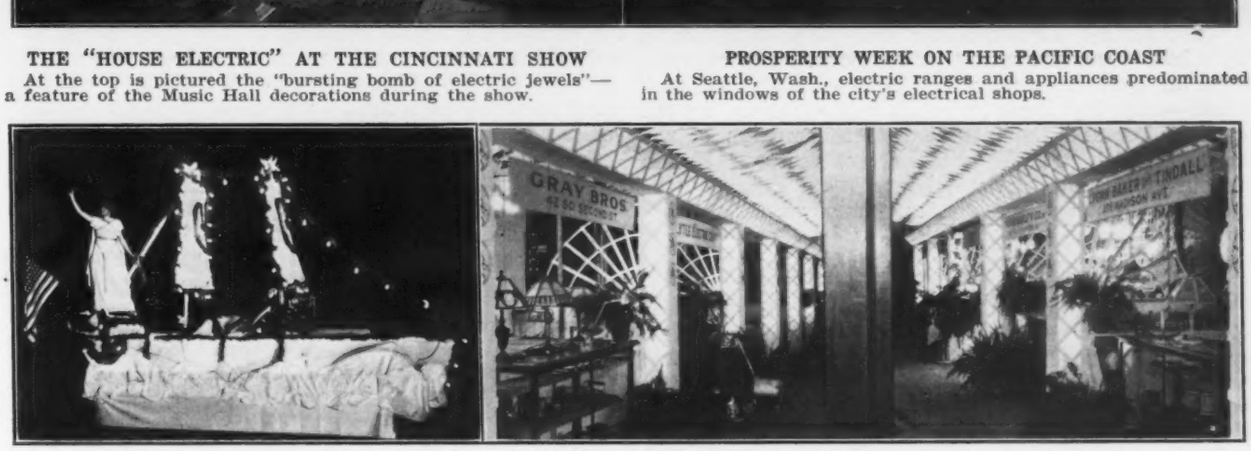


THE "HOUSE ELECTRIC" AT THE CINCINNATI SHOW

At the top is pictured the "bursting bomb of electric jewels"—a feature of the Music Hall decorations during the show.

PROSPERITY WEEK ON THE PACIFIC COAST

At Seattle, Wash., electric ranges and appliances predominated in the windows of the city's electrical shops.



"ELECTRA" AT CANON CITY, COL.

A parade of illuminated floats inaugurated the local celebration of Prosperity Week.

ADMISSION TO THE MEMPHIS SHOW WAS COMPLIMENTARY

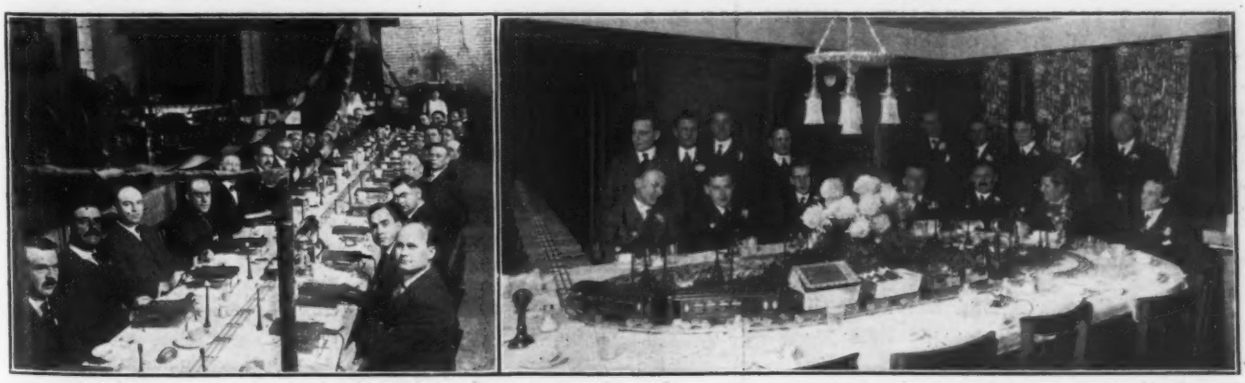
It is estimated that 45,000 free tickets were distributed by the local electrical firms during the first three days of the show.

CO-OPERATIVE BOOTH OF MILWAUKEE CONTRACTORS

An exhibit of various kinds of interior wiring at the Milwaukee show interested and instructed the public.

CENTRAL-STATION EXHIBIT AT SYRACUSE, N. Y.

Such was the success of the Syracuse electric show that it may be made an annual event hereafter.



IOWA ROTARIANS AT POWER-HOUSE BANQUET

Thirty-five leading business men of Clinton, Iowa, guests of Manager Crawford at electric dinner.

SOUTH BEND NEWSPAPER MEN GUESTS OF CENTRAL-STATION COMPANY

At a dinner in the completely equipped electrical bungalow at the South Bend show Manager Bryan passed the cigars by electric traction.

district the government was represented by two "preparedness" floats, entered by the United States Arsenal. Cash prizes were offered in many of the districts by the Business Men's Associations for the best decorated floats, the best electrically decorated windows, and the best electrically decorated buildings. These prizes aggregated $500 per night. The business houses along the routes of the parades in each district were most elaborately decorated by bunting, flags and electrical streamers.

The week in Philadelphia was an unqualified success, not only so far as the public was concerned but also from the standpoint of closer relationship between the electrical interests. The wiring offer resulted in the signing of approximately 1160 contracts, which means at least $100,000 worth of business for the electrical contracting firms. It is figured that 20 per cent of these contracts, or something more than 230, would have been secured anyway in the normal run of business, but that the other 20 per cent—or about 930 contracts—may legitimately be accredited solely to the special offer and the intensive sales campaign of the central station and the electrical contractors. In the Frankford district the merchants did a greater business than during any corresponding week in their history.

Electrical Shows at Memphis, Syracuse and South Bend

The attraction at Memphis, Tenn., was the electrical show. No entrance fee was charged, admission being by ticket secured free upon applying to any electrical retailer. During the first three days 45,000 tickets were distributed in this manner. While no record was kept of the actual attendance, the building was crowded to its capacity from the time the show opened, and it was necessary at frequent intervals to close the doors in order to allow some of the crowd to depart before new visitors were admitted.

The electric show at Syracuse, N. Y., was an overwhelming success, and the exhibitors are unanimous in expressing their satisfaction at the results obtained and insist that the show be made an annual event in Syracuse. W. O. Dell Plain, power engineer of the Syracuse Lighting Company, says: "Electrical Prosperity Week has produced results locally which we have been striving to secure for not less than five years. Chief among these results is that we have apparently succeeded in producing a spirit of co-operation among the electrical people in Syracuse which we have never even been able to approach before. This one feature is in my opinion worth all the effort and expense put forth locally in connection with this celebration." The city of Syracuse co-operated to the extent of having an exhibit which proved very interesting to the general public.

In the completely equipped and beautifully decorated bungalow at the South Bend (Ind.) electric show F. A. Byran, president and general manager of the Indiana & Michigan Electric Company, gave the local newspaper men an electrical dinner just prior to the opening of the show. As a result of the dinner all South Bend's Sunday papers were almost exclusively electrical editions, and throughout the week publicity matter for the show filled the copies of the local dailies. The show proved to be the most extraordinary exhibition of the kind the city had ever witnessed. The public showed their enthusiasm by a record attendance of 41,733.

Crowds Attend Milwaukee Show

On an average, one member of each family in Milwaukee visited the Electrical Prosperity Week electric show in that city, which opened informally on Saturday night preceding the week. In the exhibitors' spaces two features stood out pre-eminently. They were the "home electric" and the electric-cooking demonstration of the Milwaukee Electric Railway & Light Company and the co-operative booth of the Milwaukee contractors. The "home electric," a five-room apartment, was the ideal home of the man of moderate means, and contained a laundry, a kitchen, a dining-room, a living-room and a bedroom. Each room was equipped with electrical appliances.

More attention, however, was paid to the company's electric-cooking demonstration, because electric-service rates in Milwaukee have been reduced recently, so that energy for cooking can be had for practically 3 cents per kilowatt-hour. To increase interest and insure inquiries the company, just before the opening of the show, mailed a sixteen-page booklet on electric cooking, together with complimentary tickets to the show, to each of its 32,000 customers. The response to this advertising was immediate, and to follow up this interest in electric cooking a permanent cooking demonstration has been arranged in a room in the company's office building. As a further attraction the company offered to supply any appliance to its customers on six weeks' free trial.

The co-operative contractors' exhibit was conducted with the view of giving the public a wide knowledge of the various possible types of electric wiring. On the same ceiling side by side were jobs done in pipe conduit,

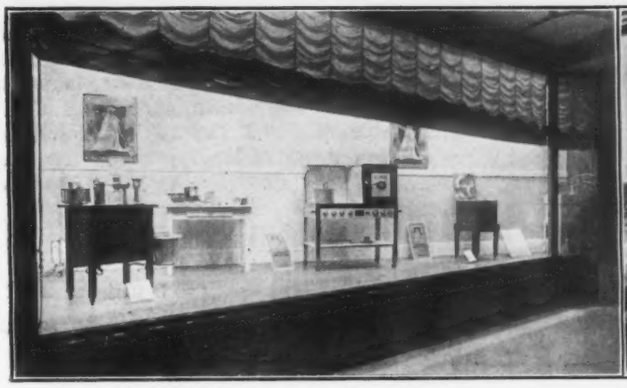
THE POPULAR "BLACK AND WHITE" SETTING OF A LAMP DISPLAY BY THE BROOKLYN EDISON COMPANY

flexible conduit, metal molding and wood molding, with porcelain cleats, with knobs and tubes, besides examples of both open-work and concealed-work types of service entrances and outlets. Each piece of work was correctly labeled. Before the show was more than three days old the exhibitors had begun to demand that it be made an annual affair. Besides the household appliances sold, there was considerable activity in the heavier apparatus. The thoughts aroused by the show were clinched by a sign which, although it was invisible to the arriving visitor, said to those departing, "Now, will you do it electrically?"

Orders for goods exceeding $50,000 were received during the first two days of the show, according to Philip Grossman, managing director of the exhibition.

Electrical Show at Cincinnati

The chief feature of the week in Cincinnati was the big electrical show at Music Hall. The exhibit of electrical devices and equipment at the show was the most extensive ever seen in Cincinnati, and the public outpouring was such as to jam the immense spaces of the hall constantly. Ample advertisement of the event, beginning several weeks beforehand, undoubtedly contributed much to its success. The light, power, rail-



A WINDOW IN CHICAGO'S NEW ELECTRIC SHOP

The headquarters of the Commonwealth Edison Company in the Edison Building was a center of Prosperity Week activity.

CHICAGO'S DEPARTMENT STORES CO-OPERATED

Several of the great State Street stores held Prosperity Week sales and featured prosperity placards in their windows.

way and telephone companies all lent their aid to the observance of the week.

The exhibit was participated in by approximately 125 electric companies in Cincinnati, including representatives of all the leading manufacturers of electrical equipment and appliances as well as all of the local electrical houses and the public-service corporations. The Electric Shop gave a demonstration of domestic electrical appliances in the form of a bungalow showing various devices in use. This proved to be one of the most popular points for the crowds and resulted directly in the sale of a considerable quantity of appliances.

The manner in which the public turned out for the show, after the first day or two, is indicated by the fact that on Wednesday, Thursday, and Friday evenings it was necessary to lock the doors for an hour or more in order to relieve the congestion inside the building and let some of the crowd leave before letting others in. The total attendance for the week, including Saturday evening, was approximately 29,000. An admission fee of 50 cents was charged to the general public, and in view of the attendance recorded the exhibit may be regarded as a financial success.

Large Sales Made in Brooklyn, N. Y.

A visitor to the Brooklyn (N. Y.) Edison Shop purchased one of the new circular three-heat electric grills during the last day of Prosperity Week. She then looked around among the other stores for suitable Christmas gifts and came back, saying, "I could find no better Christmas gifts than these grills." She then took six and gave addresses to which delivery should be made on Christmas. This is but one of many incidents which typify the great success attained by the Edison Electric Illuminating Company of Brooklyn at the Brooklyn Edison Shop during Prosperity Week. Twenty thousand invitations were sent to residential consumers, inviting them to an advance Christmas display of electric gift ware, featuring a special discount of 10 per cent on all the week's purchases.

On Nov. 29, the first day of Prosperity Week, more than $600 worth of appliances and portable lamps were sold. The sales each day averaged from $400 to $600, the greatest sale being on Saturday, Dec. 4, when more than $1,000 worth of electrical goods were disposed of to Brooklyn residents. On this day 80 per cent of the portable lamps in stock were sold. The shop was fittingly decorated for the occasion. Refreshments cooked electrically were served, and music was rendered by an electric piano and the Edison phonograph.

The Edison company, with the co-operation of the Brooklyn electrical contractors, fixture dealers and supply men, offered reductions of 15 per cent during Prosperity Week only to all Brooklyn residents signing applications to wire their homes. Special circulars were distributed by mail to 5000 prospective customers. More than 100 electrical contractors featured Prosperity Week in their window displays and carried the electrical prosperity banner on their delivery wagons. All the Edison branch office wagons were specially decorated for Prosperity Week.

Pacific Coast Celebrations

The fact that Electrical Prosperity Week was set for the closing week of the Panama-Pacific Exposition augmented the interest with which San Francisco took up the plans for its celebration. The publicity given to the event by the daily press tied it nicely into the success which has attended the Exposition and gained a hearing in the public mind for the facts and figures by which interest were drawn to electricity.

The features included a "prosperity ball" on Dec. 1 in the civic auditorium, at which "Queen Electra" appeared in the flesh on an illuminated throne and demonstrated the ease with which the electrical servants of mankind are controlled. On the closing day of the Exposition, Dec. 4, an impressive array of floats paraded the grounds, each unit typifying some phase of the industry in a manner calculated to interest and instruct, while the evening of this day was set aside for the culmination of Exposition illumination programs.

Exposition directors officially recognized the final week of the fair as Electrical Prosperity Week, and the Mayor of San Francisco issued a proclamation calling attention to this action and the specal program prepared. Three prizes for the best decorated show window prepared by a member of the California Associaton of Electrical Contractors were offered by that association.

Retail stores on the Pacific Coast dealing in electrical goods report an unprecedented business as a result of Electrical Prosperity Week. It is authoritatively estimated that seven out of every ten Christmas purchases now being made in that locality are of things electrical.

In Los Angeles the celebration was largely educational. Employees of the Pacific Light & Power Corporation held an "electrical prosperity ball" attended by 600. School children, in squads of thirty, were guided by electrical men through the electric plants of the city, and electrical prosperity was the theme at many small gatherings. Window displays featured electrical merchandise and the electrical prosperity posters to an extent that gave a distinct electrical emphasis to the entire shopping district.

There were an electrically cooked luncheon of the Jovian Electric League in the Times Building on Wednesday and a parade of electrically illuminated automobiles to the beaches for dancing on Saturday night.

CONGRESS AGAIN IN SESSION

Increased Appropriations Asked for, Much of Which Will Be Used to Purchase Electrical Apparatus

The first session of the Sixty-fourth Congress of the United States, which will be the long session, convened in Washington, Dec. 6, President Wilson personally reading his message on Dec. 7. In his message the President did not go into business subjects, announcing that he would have occasion to address Congress on other subjects upon future dates. The President dealt principally with the subject of increased military preparedness.

The greatest sum of money ever asked of a Congress in times of peace was requested in the formal estimates for appropriations submitted by the Secretary of the Treasury. This sum was $1,285,857,808, an increase over last year's appropriations of $170,843,614. Of this sum $395,000,000 is for national defense, $217,000,000 being asked for the navy and $178,000,000 for the army. This means an increase of $68,000,000 for army and land defenses this year over last and an increase of $68,000,000 for the navy this year over last year.

One new feature of the estimates is the incorporation of a proposal for a government monopoly of telephone and telegraph service in Alaska. It is proposed that the wires in these territories be acquired for the Post Office Department by proper proceedings after appraisal by the Interstate Commerce Commission, so that they may be actually taken over by July 1, 1916.

Bureau of Standards and Trade Commission Requirements

Estimates for the Department of Commerce provide for many money increases for gathering information at home and abroad on commerce, industry and manufactures. Among these items are $250,000 to promote and develop the commercial interests of the United States and $100,000 to be devoted to the same ends in South and Central America. For commercial attachés abroad $250,000 is asked this year, instead of $100,000 granted last year, and $100,000 is asked, in place of last year's $50,000, to investigate the cost of production and distribution of all articles which are or may be made the subject of tariff legislation.

Plans and estimates for a new Patent Office building in Washington are provided for.

For completing the construction of the fireproof chemical laboratory at the Bureau of Standards, for which $50,000 was appropriated last year, the sum of $125,000 is asked. For a site for a new testing laboratory at the bureau the sum of $50,000 is asked. For a fireproof building for the proposed new testing laboratory the sum of $25,000 is asked. For the construction of a fireproof laboratory building to provide for additional space to be used in research and testing in radio communication, and to enable the bureau to engage in co-operative research and experimental work in radio communication in connection with the War, Navy, Post Office and Treasury Departments, the sum of $50,000 is asked.

A total of $355,000 is estimated as the expense of the Federal Trade Commission for the coming year. Of this the salaries of commissioners, clerks, messengers, watchmen, etc., total $188,200, $50,000 being for commissioners' salaries. For the salaries and expenses of special attorneys for the commission the sum of $294,400 is asked. For contingent and miscellaneous expenses the sum of $26,966 is asked. The commission has been occupying quarters in the building of the Department of Commerce, but for next year the sum of $20,000 is asked for rent, and another sum of $15,000 is asked for mileage, witnesses' fees, etc.

The sum of $503,899, compared with $465,000 for last year, is asked for the electrical department of the District of Columbia government. The items under this head include replacing the police patrol system with a telephone system in part of the city, purchase and installation of public lamps, and the taking down of overhead wires and installing underground construction on Georgia Avenue. The additional lighting for the streets of Washington figures up about $40,000.

LEGISLATION AFFECTING THE INDUSTRY

Bills Presented at the Opening Session of Congress Dealing with the Water-Power Situation and Conservation

Nearly 4000 bills were introduced in the House of Representatives and about 1100 in the Senate during the first two days of Congress. The analysis clerks and the Government Printing Office have been swamped, and a week will elapse before all these proposed measures are sorted out, referred to their proper committees, printed and made public.

The conservation measures which failed of passage at the last Congress were among the first to be introduced. The Adamson bill, governing the construction of dams on navigable waters other than those on public lands, was the third bill introduced in the House. Judge Adamson, chairman of the House committee on interstate and foreign commerce, which has charge of the measure, said in Washington in regard to the reintroduction of the bill that it is essentially the same as last year, "but it has some changes." He would not specify their character. This is the measure which was drawn with the approval of the Secretary of War and the chief of engineers of the army.

Representative Ferris, chairman of the public lands committee of the House, also reintroduced the measure he fathered in the last Congress. This is the bill controlling dams on public land, and the one which had the support of the Secretary of the Interior at the last Congress.

Senator Thomas of Colorado introduced in the Senate a resolution which authorizes the Secretary of the Treasury to issue $500,000,000 in United States notes without interest to pay for increased military preparedness, and coincidently he introduced a resolution providing for a "Department of Communications and Transport." In his resolution as to the latter project, he says:

"The ownership or absolute control of all systems of communication and of transport by the government and their co-ordination with the army and navy organizations are indispensable to any modern military and naval system."

The resolution continues:

"Provision must be made for the acquisition by the government of all lines and systems of telephone and telegraph within the United States, and for the establishment of a Department of Communications and Transport, whose duty it shall be to operate and control the same."

Delegate Kalaniaole of Hawaii introduced a bill to provide for the manufacture, maintenance, distribution and supply of electric light and power within certain districts of Hawaii. Under this measure permission is granted to Mr. Hans Isenberg of Lihue, county of Kauai, Hawaii, or a company to be formed by him, to engage in the electric light and power industry for a term of fifty years. Permission is granted to the Government of Hawaii to purchase the plant and rights of the company at the end of twenty years.

The Hawaiian delegate also introduced several measures to amend the charter of the Hawaiian Electric Company, Ltd., in various respects; also a measure to ratify an act of the Hawaiian Legislature extending the use of

the power of eminent domain under certain conditions to public utility companies in Hawaii.

Representative Vinson introduced a bill extending the time granted to the Twin City Power Company to construct dams across the Savannah River, the proposed extension being to Feb. 28, 1919.

Representative Buchanan of Illinois introduced a bill to grant all employees in the District of Columbia one day of rest in seven, expressly stipulating telephone and telegraph companies.

Representative Cline, in behalf of the committee on foreign affairs of the House, also reintroduced the so-called Niagara Falls bill, which regulates the amount of water which may be used from the falls for power, as it was amended in the last Congress.

With reference to the Adamson water-power bill, Judge Adamson is of the opinion that the bill should be passed, largely because of the statements made at the hearings last March and April by Hugh L. Cooper, the engineer of the Keokuk dam. Mr. Cooper told of the difficulty he experienced in securing capital and of the bitter disappointments to investors many water-powers proved to be, and he gave a list of more than fifty prominent financial institutions that declined at first to have aught to do with the Keokuk development.

ANNUAL MEETING OF A. S. M. E.

Society Discusses Engineering Phases of Power-Plant Tendencies, Industrial Problems of Operation, and Accident Prevention

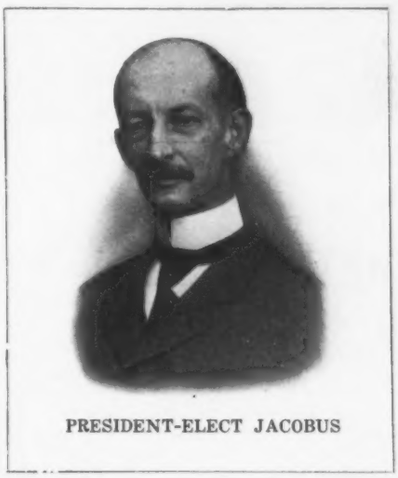
Thirty-seven papers were presented and discussed during the four days devoted to the annual meeting of the American Society of Mechanical Engineers, which opened in the Engineering Societies Building, New York City, Tuesday and closed Friday of this week. The registration list showed an attendance of 1210, including many prominent engineers.

Among the features of this meeting, aside from the discussion of engineering topics, was a stirring address by the retiring president, Dr. John A. Brashear, a memorial meeting to the late Dr. Frederick W. Taylor, the father of scientific shop management, conferences of delegates from the society's fourteen local sections throughout the country, excursions to various points of engineering interest, and special social functions.

The retiring president's address appears in abstract elsewhere in this issue. The officers elected for the coming year are as follows: President, Dr. D. S. Jacobus of Hoboken, N. J.; vice-presidents, George W. Dickie of San Francisco, Henry Hess of Philadelphia, James E. Sague of Poughkeepsie, N. Y., W. B. Jackson of Chicago, J. Sellers Bancroft of Philadelphia, and Julian Kennedy of Pittsburgh; managers, A. M. Greene, Jr., of Troy N. Y., John Hunter of St. Louis, Elliott H. Whitlock of Cleveland, Charles T. Main of Boston, Spencer Miller of New York City, Max Toltz of St. Paul, John H. Barr of New York City, J. A. Stevens of Lowell, Mass., and H. De B. Parsons of New York City; treasurer, William H. Wiley of New York City; secretary, Calvin W. Rice of New York City.

Dr. D. S. Jacobus, the president-elect, is a distinguished mechanical engineer. Graduated from Stevens Institute of Technology in 1884, he served his alma mater from 1897 to 1906 as professor of experimental mechanics and engineering physics. From 1900 to 1906 he was also in charge of the Carnegie Laboratory of Engineering. Since 1906 Dr. Jacobus has been actively connected with the Babcock & Wilcox Company as advisory engineer and head of the engineering department.

The meeting in commemoration of Dr. Frederick W. Taylor occupied the greater portion of the opening session and was marked by addresses by H. R. Towne, H. L. Gantt and Rear-Admiral Goodrich, U. S. N., each of whom paid tributes to Dr. Taylor's love for attacking and solving problems which had baffled others. Among the papers of interest to power-plant engineers were the following: "Design of Fire-Tube Boilers and Steam Drums," by F. W. Dean; "A Novel Method of Handling Boilers to Prevent Corrosion and Scale," by Allen H. Babcock; "Proportioning Chimneys on a Gas Basis," by A. L. Menzin; "Higher Steam Pressures," by Robert Cramer; "Performance and Design of High-Vacuum Surface Condensers," by George H. Gibson and Paul A. Bancel; "The Heat-Insulating Properties of Commercial Pipe Coverings," by L. B. McMillan; "Turbines Versus Engines in Units of Small Capacities," by J. S. Barstow; "Oil-Engine Vaporizer Proportions," by Louis Illmer; "The Conners Creek Plant of the Detroit Edison Company," by C. F. Hirshfeld; "Unique Hydraulic Power Plant at the Henry Ford Farm," by Mark A. Replogle, and "Foundations," by Charles T. Main.



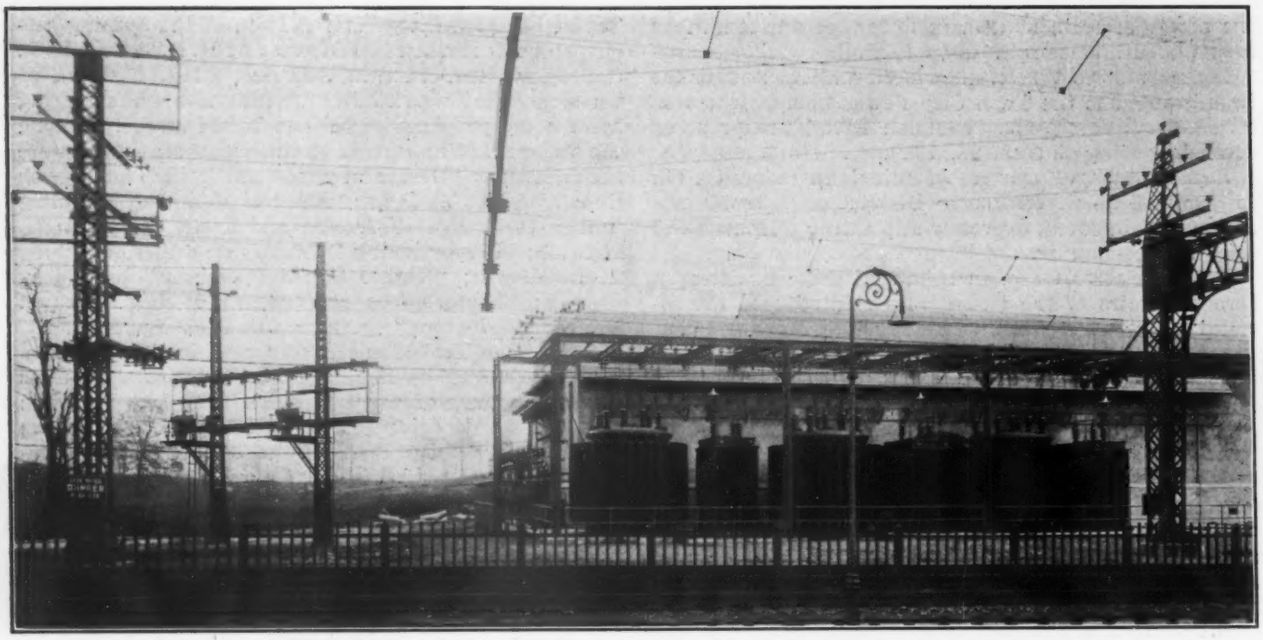
PRESIDENT-ELECT JACOBUS

Problems of interest to operators of electrically driven industrial plants were presented in the following papers: "Relative Value of Private and Purchased Electric Power for Textile Mills," by Frank W. Reynolds and Dan Adams, and "Electric Operation and Automatic Electric Control for Machine Tools," by L. C. Brooks. Data of interest to elevator builders, engineers and power-plant operators were presented in the paper entitled "Modern Electric Elevators and Elevator Problems," by David Lindquist.

Papers dealing with the prevention of accidents were presented by Carl M. Hansen, Melville W. Mix and W. H. Cameron. Among other subjects were "Application of Engineering Methods to the Problems of the Executive, Director and Trustee," by Hollis Godfrey; "The Engineer and the Business of Fire Insurance," by Joseph P. Gray, and "Electricity and Strength of Stoneware and Porcelain," by James E. Boyd.

Chairman of New York Commission Removed

Upon recommendation of the legislative committee investigating the New York Public Service Commission, Ex-Judge Edward E. McCall, chairman of the commission for the first district, has been removed by the Governor of the State. The cause arose out of the violation of a statute which explicitly prohibits ownership of stock in any corporation subject to the commission's jurisdiction. The investigation brought out the fact that Chairman McCall held 387 shares of stock in the Kings County Electric Light & Power Company.



WEST FARMS SUBSTATION, FED FROM THE 201ST STREET GENERATING STATION OF THE UNITED ELECTRIC LIGHT & POWER COMPANY, NEW YORK CITY

Feeding Heavy Single-Phase Load from Three-Phase Units—I

Energy for train operation in the electrified zone of the New York, New Haven & Hartford Railroad is now furnished from two sources, the company's generating station at Cos Cob, Conn., and a new substation fed from the 201st Street station of the United Electric Light & Power Company, New York. Before adopting this arrangement two new generating stations were planned. These stations have been made unnecessary, however, on account of changes in the distribution system, an increase in transmission voltage, and arrangements for the purchase of at least 40,000,000 kw.-hr. per year. The distribution changes, which were made more than a year ago, have called for no extensive remodeling of generating facilities at Cos Cob station and no additions to existing overhead conductors, but the connections of the latter have been rearranged to permit joining the trolleys to one side of a 22,000-volt system, the feeders to the other side, and the rails to a middle tap of auto-transformers. As in the original scheme of distribution, when single-phase power at 11,000 volts was fed directly into the trolleys and feeders from the generator bus with one terminal grounded, the potential between any conductor and the ground is 11,000 volts.

DURING the latter part of 1914 the New York, New Haven & Hartford Railroad made a long-term contract with the New York Edison Company and the United Electric Light & Power Company of New York City to supply energy for operating electric trains. Accordingly the latter company has erected a substation on the property of the railroad company at West Farms, on the Harlem River division running out of New York City. The design of this substation is in many respects similar to the electrical layout of the Cos Cob generating station, the bank of transformers receiving the service from the 201st Street generating station of the United Electric Light & Power Company occupying relatively the same position as the generators in the Cos Cob station.

Engineering Problems Involved

The railroad transmission system which the West Farms substation is required to serve is known as a semi-balanced one. The plan was adopted in January, 1914, in order to minimize inductive interference in telephone and telegraph wires and at the same time improve transmission economy. According to this plan, all trolley wires are at the same potential, 11,000 volts above the rails. The transmission system consists of two feeders on each side of the railway tracks with auto-transformers distributed along the line. The trolley wires are connected together and to one terminal of the auto-transformers, while the feeders in parallel are connected to the other with the middle point of the transformers connected to the track. This transmission scheme is similar to the Edison three-wire system except that the direct load is on one side of the circuit, the other half receiving its share through the auto-

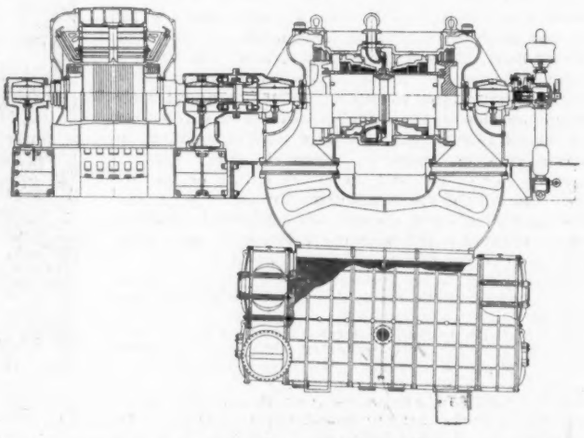
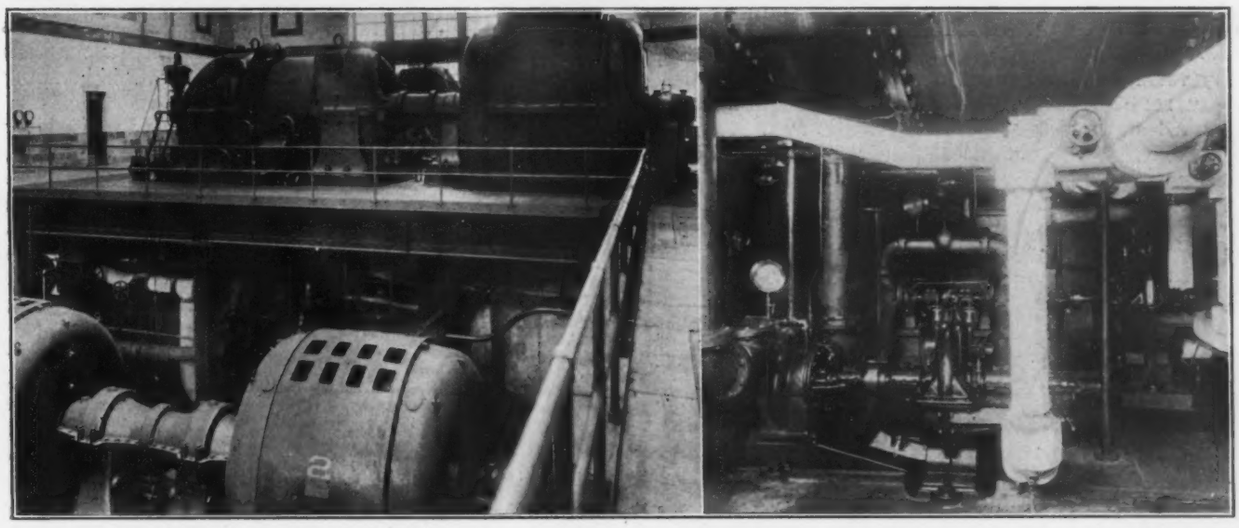


FIG. 2—SECTION THROUGH GENERATOR DRIVEN BY SEMI-DOUBLE-FLOW TYPE OF TURBINE EXHAUSTING INTO 30,000-SQ. FT. RADIAL-FLOW CONDENSER



FIGS. 3 AND 4—ONE OF TWO 20,000-KW., TWENTY-FIVE-CYCLE TURBO-GENERATORS AND A FREQUENCY-CHANGER SET FOR FURNISHING ENERGY TO WEST FARMS SUBSTATION, WITH CONDENSER EQUIPMENT UNDER TURBINE UNITS

transformers, which perform the same function as balancer sets in a direct-current distribution system. Complete details of this arrangement were published in the May 2, 1914, issue of the ELECTRICAL WORLD.

Through the change in distribution voltage regulation of the system has been improved and troubles due to inductive interferences, which would otherwise have increased with the increase of current arising from operation of recently completed extensions, have been lessened.

The problems involved in carrying the railway load, from the standpoint of the electric-service company, have included provisions for handling single-phase loads at its 201st Street steam-generating station in New York City and for the operation of the West Farms substation in parallel with the Cos Cob equipment.

Facilities Provided for Generating Railway Energy

At the United company's station have been installed two three-phase, 20,000-kw., 6600-volt, twenty-five-cycle turbo-generators, which when operating single-phase have the highest ratings yet known. One of the units is illustrated in Fig. 3. They supply energy to T-connected air-blast step-up transformers, the main units of which are rated at 5500 kva. These units, also, are the largest of their kind yet made. They, in turn, furnish energy to one-to-one ratio T-connected self-cooled transformers at the West Farms substation. This bank of three main units rated at 5000 kva. each and three teaser units of 1000 kva. each is shown in Fig. 1.

Although 40,000 kw. in generating apparatus has been added to the 201st Street station, the boiler-room equipment has not been extended since the thirty-two boilers already installed are capable of carrying the entire railway, power and lighting load of this station. A description of the station before the railway equipment was added was given in the Feb. 7 and 14, 1915, issues of the ELECTRICAL WORLD.

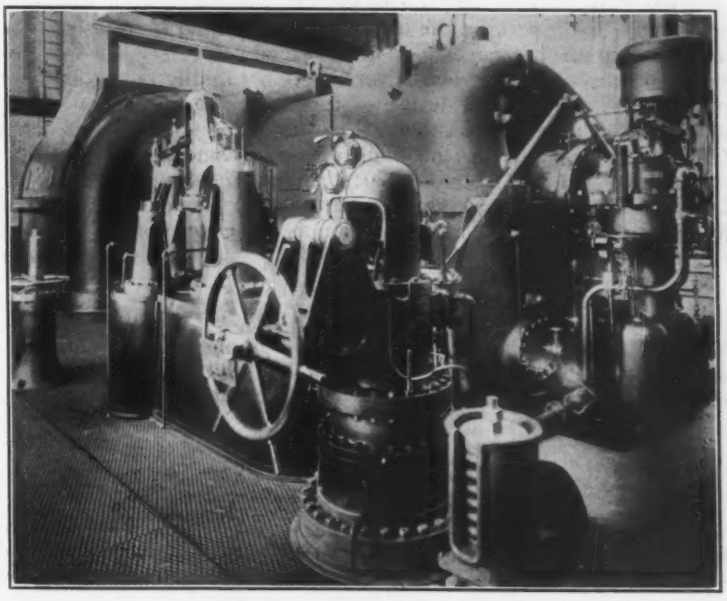
The turbines driving the railway generators are somewhat similar to the sixty-cycle turbo-generators which have been in operation in this station for about two years, but instead of being of the double-flow type, they are Westinghouse semi-double flow, having an impulse element, a single-flow intermediate section of reaction blading and a double-flow low-pressure section. They are designed to operate at 185 lb. steam pressure and 100 deg. superheat.

When the turbo-generators are operating three-phase at 100 per cent power-factor the steam consumption of the turbines will not exceed 14.3 lb. per kilowatt-hour

Features of the Turbines

Since the load demands on the turbines extend over a wide range of rating, it was desirable that the turbine economy, as expressed by pounds of steam per kilowatt-hour, show a flat characteristic. In order to accomplish this, the steam admission is controlled by three automatic inlet valves, two of which admit steam through nozzles to the impulse wheel and carry loads up to about 15,000 kw. The third admits steam to the reaction element, supplying steam to carry loads in excess of 15,000 kw. and up to the rating of the machine. Part of the steam admitted through the primary valve may be utilized through an additional nozzle by a hand-operated supplementary valve, this valve being under the control of the governor when once cut in. Means are provided so that the governor spring tension may be varied during operation to adjust the loads on the turbines.

The units are prevented from running above a safe speed by automatically operated quick-action safety stops acting on the throttle. This mechanism may also be tripped by hand. Water-sealed glands are employed where the turbine shaft passes through the ends of the cylinders, so that lubricant is not required there. The lubrication of all main bearings is effected by a continuous circulation of oil through a system consisting of the piping, receiving reservoir, cooling coils, strainer and a pump driven through worm gears by the turbine shaft.



with a load of 5000 kw., 12.07 lb. with 11,000 kw. and 12.63 lb. with 20,000 kw. When using the supplementary valve previously mentioned, the steam consumption is guaranteed not to exceed 12.1 lb. per kilowatt-hour with a load of 13,000 kw. and 12.13 lb. with 15,000 kw. The consumption when operating single-phase at 70 per cent power-factor will not exceed 14.37 lb. with a load of 5000 kw. and 12.14 lb. with 11,000 kw.

Radial-Flow Condensers and Turbine-Driven Auxiliaries

Each turbine is connected with a 30,000-sq. ft. radial-flow surface condenser supported from directly beneath by floor beams and connected with the turbine by expansion joints. The tube sheets are made of Muntz metal, and the tubes, of which there are 6600, 1 in. in diameter and about 17 ft. long, consist of No. 18 B. W.G., Admiralty mixture (Cu70, Zn29, Sn1). The water boxes are arranged so the tubes are flooded at all times, and the condenser is set with a pitch of 1 in. in 10 ft. so the tubes will drain toward the outlet end of the condenser.

All of the condenser auxiliaries are driven by turbines which exhaust into feed-water heaters. Cooling water (salt water from the Harlem River) is drawn from a tunnel under the condenser and forced through each of them by a triplex impeller-type centrifugal pump connected with a 150-hp., 2500-r.p.m. turbine by ten-to-one self-aligning double-helical reduction gears. When delivering 34,000 gal. of water per minute this unit will not require more than 4200 lb. of steam per hour. Each gear is equipped with a pressure gage from which the horsepower that is transmitted through the gears can be computed.

Westinghouse-Leblanc air pumps directly connected with 85-hp., 2500-r.p.m. turbines are employed to evacuate air from the condensers. They lift their own water from the cold well and discharge against a head not exceeding 12 ft. including friction. The turbines will not require more than 2550 lb. of steam per hour when operating at rated load.

Condensate is removed from the condenser by centrifugal pumps driven by 20-hp., 1800-r.p.m. turbines. The discharge head external to the pumps is not more than 40 ft. The steam consumption of each condensate-pump turbine is guaranteed not to exceed 1000 lb. per hour at rated load, making the total steam consumption for the auxiliaries not to exceed more than 7750 lb. per hour.

All of the pumps are equipped with bronze runners and bronze-covered shafts. Their turbines are provided with Nelson throttle valves. To permit priming the circulating system air ejectors are provided. Relief valves are connected between each turbine and an atmospheric exhaust.

With 34,000 gal. of cooling water per minute (at 65 deg. Fahr.) the condensing equipment can maintain a vacuum of 29.16 in. with 70,000 lb. of steam per hour and 28.18 in. with 270,000 lb. per hour. The values given are based on a 30-in. barometer reading. The temperature of the hot-well water will not be more than 5 deg. Fahr. below the temperature corresponding to the vacuum measured by a mercury column connected with the top of the condenser.

Generators with High Single-Phase Ratings

Except for active core length, the generators are similar to the three 11,200-kva. units used by the Norfolk & Western Railroad. They can carry 21,000-kva., single-phase loads at 60 per cent power-factor for two minutes succeeding a twenty-four-hour load of 14,300 kva. at 70 per cent power-factor and a seven-minute load of 17,600 kva. at 65 per cent power-factor. This is the highest single-phase rating which the manufacturer will recommend unless present design, experience and limits are exceeded. At these loads field heating rather than armature heating was the main consideration in fixing the limit to rating.

With the highest single-phase rating advocated for these units a rise of 120 deg. C. may occur in spots, giving an actual temperature with 40 deg. air of 160 deg. C., probably the highest accepted by any operating company. The electric-service company, however, felt safe in accepting machines with these temperature rises inasmuch as the railway service will not require the maximum possible output of the generators for long periods, as might be the case if the units were supplying a lighting and industrial motor load. Instead, maximum demands are intermittent and usually of short duration, such as occur during the acceleration of the trains.

Occasionally these twenty-five-cycle generators will be required to operate in parallel with a 7500-kva. motor-generator set fed from 19,000-kva., sixty-cycle, three-phase generators installed in this station. The reactance of each single-phase generator armature is 8.5 per cent; thus the instantaneous short-circuit current is limited to eleven and nine-tenths times the rated full-load current in case the current wave is symmetrical, but may be double this value if the wave has the maximum possible displacement.

Arrangement of Windings

Damper windings constitute one of the most important elements in large single-phase generators. In these units the dampers consist of axial copper bars attached to copper end rings embedded in steel retaining rings. It may be pointed out also that the portions of the main windings nearest the air-gap consist of eight 0.229-in. square wires to reduce eddy-current losses, while the remainder of the windings consist of ⅜-in. by ½-in. straps. Mica strips, tape and wrappers are used exclusively for insulating these coils, fiber wedges being employed only for retaining purposes. An axial ventilating space is left in each slot nearest the air-gap. Before the coils were installed in the machines they were subjected to 45,000 volts for one minute, the machine itself being later subjected to 30,000 volts for a like period. The windings of the generator field coils consist of copper strap suitably insulated with asbestos and mica.

Ventilation and Excitation of Generators

Air for cooling the generators is first chilled, humidified and washed by Metropolitan air washers, and then forced into the end bells of the units by motor-operated blowers. Each blower will supply 60,000 cu. ft. air per min. and is driven by two three-phase, 440-volt motors, each capable of running the blower alone, so that if one fails operation will not be suspended. Separate circuits are run to each blower motor to further insure reliable service.

The generators can be excited from the general exciter bus in the station, but two additional exciter sets have been installed as a reserve. These sets are similar to the others in the station and consist of shunt-wound 250-volt generators driven by 7500-volt induction motors. While rated at 250 volts the exciter can operate at higher voltages for short periods without injury to charge the storage battery which ordinarily floats on the exciter bus. Westinghouse voltage regulators acting on the exciter fields control the voltage of the main generators.

The next section of this article will take up the engineering details of the transmission and substation arrangements to furnish the single-phase train service already outlined.

Free Lamp Renewal Policy of Edison Companies

Control of Incandescent Electric Lamp Supply to Consumers Held to Be Essential to Good Lighting and to the Welfare of the Public

RECENTLY there has been some sentiment expressed in favor of allowing electrical contractors and dealers to handle the incandescent electric lamp business at a profit to themselves. It has been urged that the consequent increased co-operation between these men and the central station would promote the best development of the electric-lighting industry.

Various Ways of Handling Lamps

Some central-station managers have believed that by thus favoring local contractors and dealers they would be assured of a certain measure of good will and co-operation on the part of the latter. Some are of the opinion that the incandescent-lamp product is now so thoroughly standardized that it is perfectly safe for them to unload this burdensome service, which entails so much detailed attention to consumers, and that relinquishing lamp control will not have any great effect on the quality of the lighting service. Still others believe that economies may be realized by abandoning this service and shifting the lamp business from the central station to the local supply dealers. Yet others, under pressure from regulatory bodies to reduce their maximum rate to as low a figure as possible, have found it necessary, in order to meet this pressure, to take the lamp service out of the price for energy and make a separate charge for lamp service, or to supply lamps as a separate sales transaction. Inasmuch as the number of companies that have committed themselves to some such departure from the tenets held by the Association of Edison Illuminating Companies is as yet small, the report of the lamp committee of the Association of Edison Illuminating Companies bearing on this subject is of interest.

According to the report of that committee, the member companies of the Association of Edison Illuminating Companies are striving to furnish the best service, and in proportion as the local conditions permit they are doing so. They are expending liberally money and engineering effort to make all features of service of the very best, right up to the customers' meters. The committee asks: "Shall their efforts cease at that point? Shall they stop at the translating device, which after all is the keystone of the arch and which interprets kilowatt-hours, themselves not useful, into the useful candle-hours of illuminating effect?" It answers: "Obviously they cannot, unless they can be assured that conditions beyond that point are excellent. The appliances which customers employ must be effective and satisfactory, or else the best of operating conditions and the provision of the most efficient generating and distributing equipment avail but little."

Importance of Incandescent Lamp to the Industry

Of all the appliances for the operation of which central-station energy is supplied, the incandescent electric lamp is the most variable, the most non-uniform, the most sensitive to variations of operating conditions, the most difficult to select and to safeguard, and it is the most liable to misuse. At the same time, the incandescent lamp is the principal translating device with which the customer comes in contact and by far the most appealing, revealing as it does at once, visually and forcibly, any defects in the service. It is more generally used than any other appliance, and, its service being a more prominent and observed feature, it commands more attention and consideration from the public than do all other devices. In short, the committee says that the public at large judges central-station service by the excellence of the lighting. These facts have led most of the Edison companies, and particularly the larger ones, which are naturally most critical about the excellence of their service, to devote a great deal of attention to the incandescent lamp. They have controlled the supply of lamps to customers; they have made it their business to see that customers obtained the very best lamps of the highest commercial efficiency, and by so doing they have established in this country, it is claimed, a standard of lighting excellence not equaled elsewhere, and have made difficult the introduction of lamps of an inferior grade which would prove unsuitable for the service.

Changes Brought About by Tungsten Lamp

Facing the condition brought about since the introduction of the tungsten lamp, the committee says, the manufacturers have so standardized and simplified processes that the tungsten lamp the members obtain is the most highly developed, most efficient, most uniform and generally satisfactory type of incandescent lamp which has ever been offered for lighting service. This fact has tended to engender a certain feeling of false security regarding the lamp situation that has led some to believe the incandescent lamp is now so thoroughly standardized and so uniformly excellent in quality that central stations may without concern relinquish control of the supply to their customers.

Underlying all proposals for relinquishment of control of lamp supply to customers must be, says the committee, as a first consideration, that the service will not suffer, and, as a second consideration, that there shall be some economic advantage accruing to the company, to the public, or to both, under such a policy. The committee reports that the survey which it has made, together with considerations growing out of its general knowledge of the situation, makes it absolutely certain that the service would be affected deleteriously if the central stations were to cease handling lamps, making it necessary for their customers to obtain their lamps where they may. The general opinion found by the committee among the Edison companies seems to be that selling agreements with contractors and supply dealers mean co-operation by the central station, with little if anything in the shape of reciprocal advantages. That the handling of lamps and their delivery to consumers is a feature of the business that is troublesome and a source of expense above the immediate special returns may be assumed; but the important question to be answered is whether the abandonment of the practice will result in the long run to the economic advantage of the company or of the public.

There is much to be said in favor of maintaining general trade prices for lamps sold separately to consumers when they are not included in the rate, but favorable consideration of such a policy, according to the committee, should be predicated on the control of the quality of the lamps on customers' circuits being in a fair measure effective. If it is ineffective, the disadvantages far outweigh anything that can be said in its favor.

Means of Control by Central Station

The advantages of controlling the supply of lamps to central-station customers is so marked that the majority of the Edison companies are strongly in its favor, more strongly than ever, according to the committee. Means of control are, however, of several kinds. A number of the largest companies supplying graphitized-filament lamps as a part of the service include tungsten lamps of 60 watts and larger in their renewal service and contemplate including the prospective 50-watt tungsten lamp as well. These companies are well pleased with their experience, finding that the plan possesses all of the well-understood advantages, including satisfied customers, sockets kept filled with operating lamps, high standard of lighting excellence, etc. Where the standard lamps are furnished as free renewals within the rates for energy, companies make a small additional charge for lamps of 40-watt rating and less to cover the additional cost per kilowatt-hour of these lamps.

Where the so-called free renewal practice is not followed, it is the practice of some of the Edison companies to sell tungsten lamps at or near net cost to them, thus underselling local contractors and dealers. If the prices are but slightly below list, this practice sometimes operates to induce supply dealers to handle inferior lamps which they can purchase at a lower price and resell to customers at a price to meet the competition of the central station. When central-station lamp prices are made so low as to present a notable differential as compared with the resale price of the supply dealers, the central station is able to maintain a fair measure of control, second only to the complete control obtained through the free-renewal policy. Some Edison companies sell tungsten lamps at general trade prices, attempting to retain a weak control by more vigorous merchandising methods than those of the local contractors and supply dealers. The committee says it is not known to what extent this method may be effective, if at all, in controlling the supply of lamps, but the policy, if it can be made effective, enables the central station to make a profit on the lamp sales, which may or may not be considered to be an advantage. At least one Edison company contemplates a plan whereby the contractors and dealers will be allowed to handle all of the lamp business, selling tested lamps under central-station supervision. In this way the central station hopes to retain control of the lamp supply in the interest of its customers without itself handling lamps.

Some Edison companies have felt that they were maintaining a sufficient measure of control over the lamp supply by allowing the bulk of the business to drift to contractors and dealers upon agreement to sell only the Mazda product. This method offers but little hope of effectiveness, since the committee's survey shows that even Mazda lamps put out by dealers in the usual manner are unsatisfactory. It is known besides that some dealers who have agreed to sell Mazda lamps, while they advertise Mazda lamps and sell them upon demand, also sell to undiscriminating purchasers other and inferior lamps at the same price, thereby securing a larger profit on the sales.

It is the committee's conclusion that the control of the supply of lamps by the central station is absolutely essential to the present and future good of the service, and it urges member companies that by whatever means may be desirable and practicable, and in such measure as it can be accomplished having always due regard to the particular local conditions, each company take steps to secure to itself control of the local lamp supply to its customers, in the interest of the latter and for the purpose of maintaining the highest standard in its service to the public.

Science in Its Relation to Engineering

Dr. John A. Brashear, President of the American Society of Mechanical Engineers, Traces the Evolution of Scientific Research and Its Correlation with Engineering Problems

A most admirable address on "Science in Its Relation to Engineering" was delivered by Dr. John A. Brashear, president of the American Society of Mechanical Engineers, at the annual meeting of that organization in New York this week. He enumerated the achievements of ancient times in the many lines of civil and mechanical engineering, noting that the works of the ancient Egyptians, Greeks and Romans were constructed largely upon empirical bases with factors of safety amply large.

The great geometers and mathematicians of the past, the author said, made splendid contributions to human knowledge and bequeathed to posterity the key that has enabled other master minds to solve some of the mysteries of the universe. There is not a single problem in modern engineering, said Dr. Brashear, that cannot be more readily solved by a knowledge of facts developed by scientific study and research, and no man knows this better than the successful engineer of to-day. Dr. Brashear said he always has had the conviction that engineers give too little thought to the pioneers in any line of research, who, with the most limited means and equipment, by patient, persisting plodding wrested the secrets of nature from their entanglement. There is but a hazy line between pure science and applied science. When the velocity of the propagation of light waves was determined by scientific reasoning and experimentation of the most refined nature, the process of solving the problem remained for a long time in the domain of the exact sciences as a masterpiece of the human mind. Applied, however, it gave to the world a value for the international meter in terms of light waves that will remain absolutely unalterable as long as this old world moves in the luminiferous ether of the universe.

Dr. Brashear paid a tribute to American engineers who have developed instruments for mechanical measurements to a very high state of precision, which in their turn have been mighty factors in the development of interchangeable machinery. He cited the diffraction grating made accurate within one forty-five-thousandth of an inch and rendered possible, first by rigorous scientific research, second by the skill of the artisan, third by a knowledge of and care to avoid temperature changes, and fourth by the accuracy of the mechanism which includes the screw. Dr. Brashear also reminded his hearers of what has happened in the domain of electrical science since the first little dynamo of Faraday and the telephone of Bell. He likened the application of science to the arts and industries to the "widow's cruse," and regretted that he could not go into very many fields where pure science may take the hand of fellowship of the engineer. The address concluded in the following words: "To-day we are learning but single notes; to-morrow we will blend them into chords; the hour will chime when all humanity shall know the law of harmony—when every note in every chord shall find its part in the sublime oratorio of the universal life."

The Design and Operation of Horn-Gap Fuses

Suitable Types of Fuses for Small Outdoor Substations, Their Behavior on Short-Circuits and Overloads, and Essential Features of Construction

BY E. A. DILLARD*

IN order to be able to give reliable and uninterrupted service from modern high-tension transmission systems it is becoming very important to plan and relay the switching so that the line or piece of apparatus in trouble will be automatically dropped in as short a time as possible. With this scheme operative it has been found that in the majority of cases the trouble will clear itself and that the line may be replaced in service immediately. The cost of repairs on all lines is also greatly reduced with such operation. Oil switches and relays have now been developed to such a stage that this scheme may be readily carried out in installations that will warrant the expenditure. However, there are many cases where it is desirable to serve customers whose business is too small to warrant the installation of any but the simplest substations. Protection against overload and apparatus failure is in these cases essential, and general practice has called for the installation of a high-tension fuse of some sort.

To be acceptable for modern high-tension operation, a fuse should embody the following characteristics: It should break the circuit in which it is installed under short-circuit conditions in a short period of time, say in thirty or forty cycles at the longest. It must be made

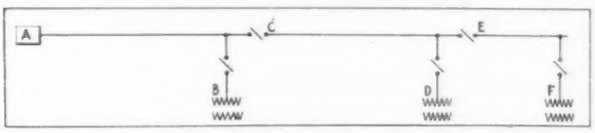


FIG. 1—SUBSTATION LAYOUT, SHOWING DESIRABILITY OF SELECTIVE ACTION OF FUSES

of a metal that has a definite time-current characteristic that is unaltered by successive heating and cooling or by age. It must be constructed so that it will positively prevent arcs blowing or forming from phase to phase.

While there may be other metals that are equally good for use in fuse construction, the writer has accepted and used annealed copper wire in all high-tension work. The principal reasons for the use of this wire are that copper is more readily obtained in desired sizes, and data covering its electrical characteristics are more complete. There has been no real reason to consider adoption of any other metal.

It is not a difficult matter to compute the time-current characteristic curve of a copper-wire fuse of given size, as all of the factors that cause the fusion of the copper are perfectly definite and can be calculated by well-known laws of physics. The heat required to fuse a wire is the sum of the heat necessary to raise the temperature of the wire from air temperature to the temperature of fusion for copper, plus the latent heat of copper, plus the heat lost in radiation. The heat lost in radiation is relatively small, ranging from 5 per cent to 10 per cent of the total heat, and can be neglected without seriously affecting the results. Also, the heat generated in a given size of wire by a given current is simply the product of the I^2R loss in watts in the wire by the time in seconds by a conversion constant of 0.0009478. The result is in (F. P. S.) units of heat. Knowing the heat required to fuse a unit length of wire and the heat generated per second in any size of wire by a given current, the time that is required to fuse the wire by different values of current may be computed. It is a good plan to plot a set of curves between time and current for all sizes of wire from No. 10 B. & S. to No. 30 B. & S. for reference use. Such a curve for No. 18 wire is shown in Fig. 2.

From impedance calculations of transmission lines and generators one may compute what value of short-circuit currents to expect at different points. Knowing this, a size of fuse may be installed that will give the selective action desired at any point. For example, consider the following case, illustrated in Fig. 1: Suppose a feeder leaves a substation through an automatic oil switch *A*, equipped with definite time-limit relays, and connects with station *F*, serving on the way stations at *B* and *D*. *C* and *E* are fused sectionalizing switches at substations *B* and *D* respectively. Let us say that from line calculations 300 amp. will flow into a short-circuit at *F*, 400 amp. at *D*, and 500 amp. at *B*. The oil switch should be considered as a reserve and set so as to trip on a short-circuit, even at the very end of the line, so as to guard against fuse failures. It must have a time setting long enough to give the fuses time to operate. In this case a setting of 275 amp. and 3 seconds would probably be satisfactory. Trouble at *F* should be cleared off without disturbing service to substation *B* or *D*. This may be accomplished by installing a fuse of No. 20 B. & S. wire at the fused switch *E*, which will fuse in 1.2 seconds with 300 amp. flowing through it. thus beating the relay setting of 3 seconds at *A*. Likewise a No. 18 B. & S. wire installed at *C* will open in 1.7 seconds when trouble develops at *D* and in advance of oil switch *A*. With a "short" at *F* of 300 amp. this fuse will open in 3.2 seconds, which is a longer time than required by the fuse at *E*. Trouble between *A* and *C* must then be taken care of by the operation of the oil switch *A*.

With open-type horn-gap fuses installed in this system considerable trouble was experienced in making the fuses operate in this definite manner. The difficulty was not in determining the time required to melt the

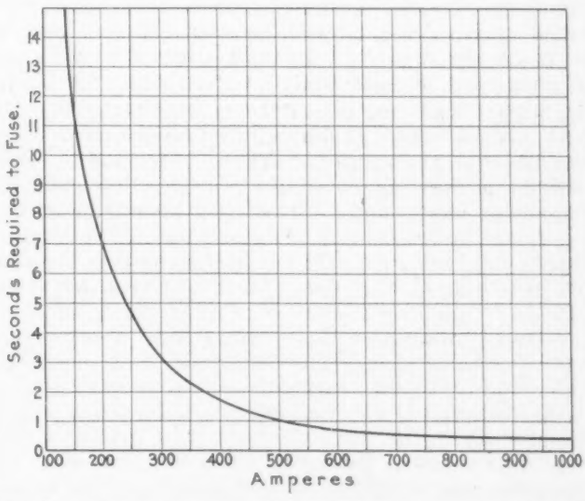


FIG. 2—TIME-CURRENT CHARACTERISTIC CURVE FOR NO. 18 B. & S. GAGE ANNEALED COPPER FUSE WIRE

*Assistant engineer Alabama Power Company, Birmingham, Ala.

copper, but in making a reliable estimate of the time required to "clear off" the arc that results from a fuse opening. Considerable time has been given to experiments in shaping horns so as to determine a shape that would be most efficient and break arcs in the fastest time. However, it has been found that with the "fastest" horns the time required to break an arc is comparatively a long period and varies with the amount of current in the arc. Besides this, the horn-type fuse presents an additional difficulty as the arcs resulting from a set of fuses opening are liable to intermingle, giving a second short-circuit, but at this time more dangerous, as it is nearer the source of power. To clear this it is usually necessary to "kill" the entire feeder and cause an interruption to several customers who should not have been affected by the original trouble.

In Figs. 6*A* and 6*B* examples of arcs intermingling are shown. These arcs were started by the fusion of

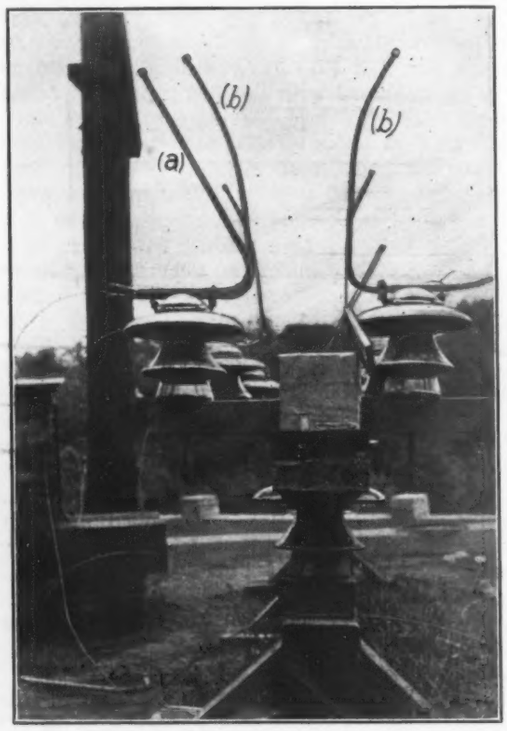


FIG. 3—SHAPES OF HORNS TESTED WITH DIFFERENT FUSES. SHAPE *b* WAS FOUND MOST EFFICIENT

two strands of No. 22 with between 150 amp. and 220 amp. at 22,000 volts. Observe that with the shape of horn used there seems to be no tendency for the arc to rise more than one-fourth of the way to the horn tips. The most efficient shape of horn found is shown as *b* in Fig. 3, *a* being the shape of horn used in Figs. 6*A* and 6*B*. In Figs. 6*C* and 6*D* fuses of No. 20 B. & S. copper are opening with the shape of horns shown at *b* (Fig. 3). Note that In both pictures the arc rises to the top of the horns. The time required to open this arc was only about one-half the time required in the horns of other shapes.

It is of interest to note some of the difficulties that have been experienced in the operation of the open-horn-type fuses. The horns were made of galvanized-iron pipe, bent about 120 deg. to form a horn about 3 ft. high, as shown in Fig. 5. A bolt was placed through the horns near the bottom to clamp the fuse wire, and the fuses were installed by wrapping the wire several times around the horn and fastening it under the bolt. Although galvanized, there was more or less rust on

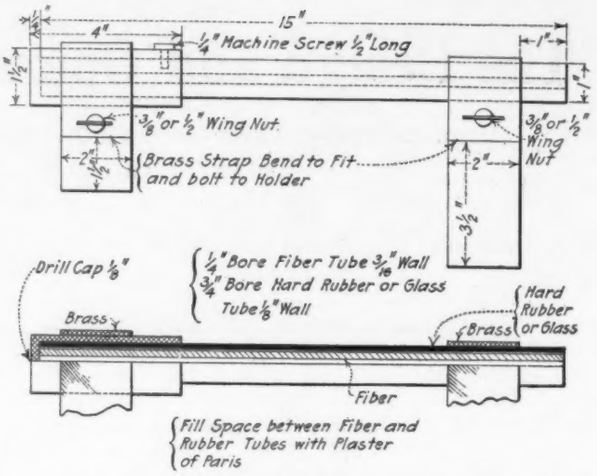


FIG. 4—A COMBINATION GLASS AND FIBER-TUBE TYPE OF FUSE ARRANGED TO FIT 100-AMP., 600-VOLT KNIFE-SWITCH CLIPS

the horn at the place where the fuse was attached, which resulted in poor contacts. Finally a minute arc started and was maintained until the fuse opened or until it had eaten away enough copper to cause the fuse to break from mechanical stresses, such as wind or slight movement of the horns. It is also difficult to impress upon the average troubleman that it is important to install these fuses without kinking the wire and without putting tension on the fuse wire itself.

From time to time numerous improvements have been proposed for use in fuse horns to take the place of the open fuses. One of the most satisfactory has been the fuse made up of fiber tubes packed with plaster of paris. These designs usually break an arc in a short time, but they are mechanically weak. The tubes are liable to burst and give an arc as serious as the open-type fuse. In Fig. 7*A* is shown a fiber-tube fuse breaking about 50 amp. at 22,000 volts. Another type of fuse that has been used consists of a glass tube (gage glass) packed with plaster of paris and stoppered at each end. The glass breaks and most of the time extinguishes the arc, but there is a chance of failure which would also give a bad arc. Fig. 7*B* shows a fuse of this type extinguishing an arc formed by the fusion of a No. 20 B. & S. copper wire on a 22,000-volt circuit. Fig. 7*C* shows an

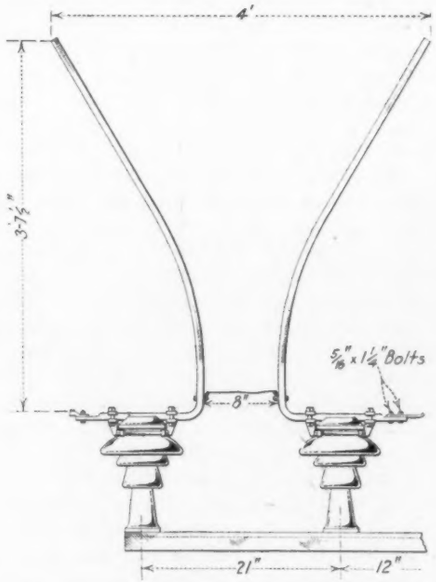


FIG. 5—CONSTRUCTION OF HORN-GAPS FOR FUSES

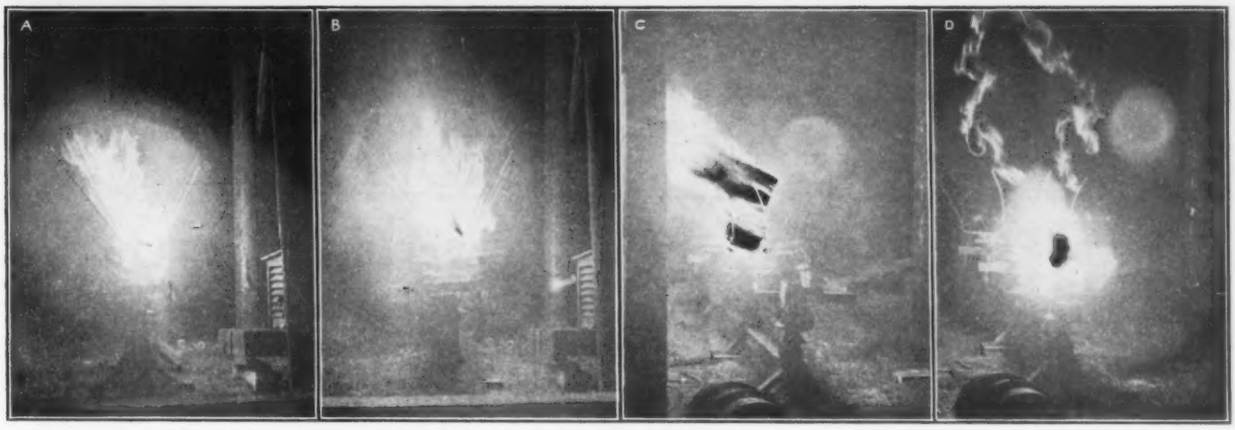


FIG. 6—ARCS DUE TO BLOWING OF COPPER-WIRE FUSES WITH DIFFERENT SHAPES OF HORN-GAPS SHOWN IN FIG. 4

The arcs in *A* and *B* are due to fusion of two strands of No. 22 B. & S. gage copper fuse wire at 22,000 volts. The shape of horn marked *a* in Fig. 3 was used. In *C* and *D* the arcs are due to blowing of No. 20 B. & S. copper wire with shape of horn shown as *b* in Fig. 3.

arc formed from the failure of this fuse to operate satisfactorily. Out of seven of these fuses tested at this time four operated satisfactorily and three failed.

While there are a number of fuses on the market that are satisfactory for high-tension work, most of them are expensive. The writer has therefore attempted to design a fuse that may be replaced at a less expense. An outline and a sectional view of a fuse design that has been adopted is shown in Fig. 4. This fuse is made of a fiber tube sealed in a glass tube and capped at the end by a heavy brass fitting. Fiber itself is hard to waterproof satisfactorily, so that the entire tube has been inclosed in glass. The ends of the tube are sealed with a cement to prevent moisture from entering. The contacts are made of strap brass of such a size as to fit into 100-amp., 600-volt knife-switch clips. The front contact strap is made longer than the rear strap so as to elevate the mouth of the fuse. This throws the arc out and away from the supporting insulators. Mounted in this way, there is also considerable force placed on the fuse, tending to throw it out of the holder. As the arc clears off practically instantaneously, there is no danger of the switch clips having to break any part of the arc. It is important to double the fuse wire to a point about one-half way in the tube. This insures the fusion inside the tube and near the rear end.

In Figs. 7*D*, 7*E* and 7*F* examples are presented of this expulsion fuse opening a short-circuit on 22,000 volts when fused with No. 20 B. & S. copper wire. The vapor was expelled possibly 30 ft. from the mouth of the fuse, and in ten tests the arc was quickly broken and the holder showed no deterioration.

All of the tests mentioned were conducted with two 1000-kva., 150 r.p.m. waterwheel-driven generators paralleled on a 2300-volt bus. The voltage was stepped up to 22,000 volts through a bank of three 667-kva. transformers connected delta-delta. The impedance of this combination has been computed as approximately 15 per cent on the basis of one 1000-kva. generator. The 2300-volt transformer switch was closed on the short-circuited branch line to the fuses while the machines were operating at normal frequency. At the instant of closing this switch a second operator brought up the field on both machines to the highest excitation. A third operator opened the gates on both waterwheels to the extreme open position. It is believed that this method of testing gives conditions as severe as might be expected with a short-circuit on the average power feeder.

These fuses have been found nearly as satisfactory in their operation as an automatic oil switch, excepting that it is possible to obtain only one automatic feature, namely, inverse time limit. Of course, with oil switches there are many combinations that can be worked out by using definite time-limit relays and reverse-energy relays, but in the protection of a straight power feeder these features are not often required. Further, an automatic oil switch for 22,000-volt service costs at least $600. A set of horn-gap fuses installed costs less than $50, and may be refilled at a very small cost. While there are many features favoring use of an oil switch, every operating engineer appreciates that there are many cases in which a profitable business can be secured provided that an inexpensive substation can be installed and satisfactorily operated. In these cases the question of protection can often be met by the installation of an air-break switch fused with expulsion-type fuses.

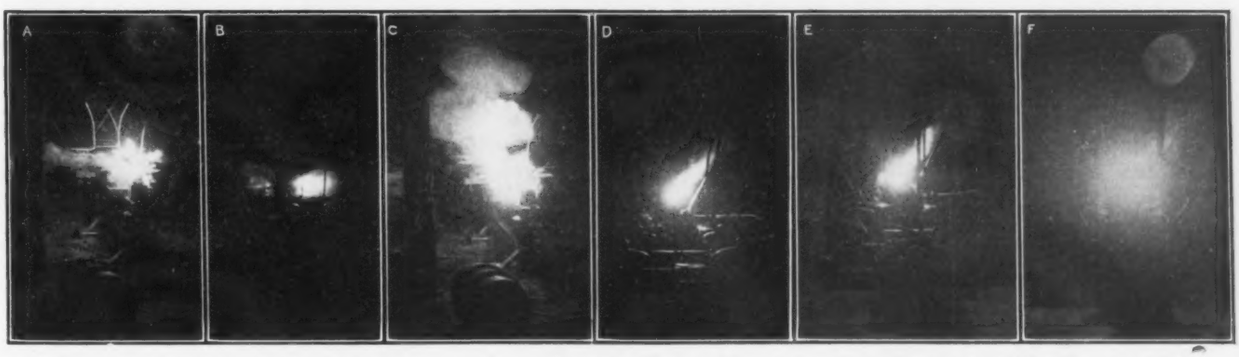


FIG. 7—ARCS DUE TO BLOWING OF DIFFERENT TYPES OF EXPULSION FUSES WITH HORN-GAPS ON 22,000-VOLT CIRCUITS

A shows a fiber-tube fuse breaking 50 amp. at 22,000 volts. In *B* the successful rupture of a glass-tube fuse packed with plaster of paris is shown. *C* shows the arc resulting from failure of the fuse in *B* to operate satisfactorily. *D*, *E* and *F* show action of the type of fuse shown in Fig. 4 when using No. 20 B. & S. gage copper wire and opening a short-circuit at 22,000 volts.

Station and Operating Practice

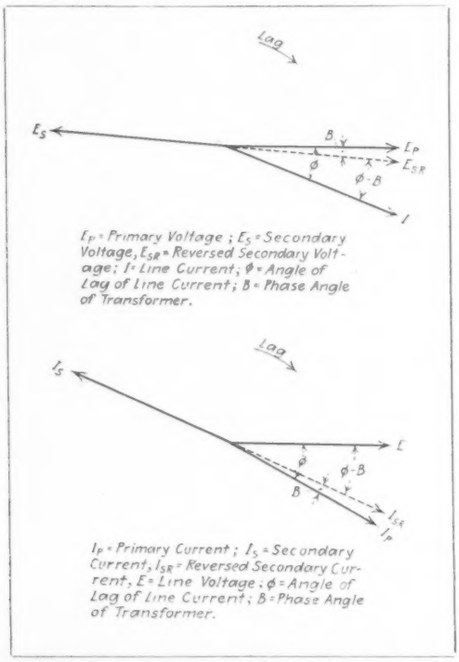
A Department Devoted to the Problems of Installation, Operation and Maintenance of Equipment for the Economical Generation and Distribution of Electrical Energy for All Uses.

Errors Due to the Use of Instrument Transformers

Effect of Angle of Phase Displacement Between Primary and Reversed Secondary Current or Voltage of Instrument Transformers Used with Watt-hour Meters—Method of Calculating Errors Introduced

BY R. H. CHADWICK

THERE has always been more or less speculation on the exact effect an instrument transformer has on the accuracy of the instruments connected to it. Central-station engineers are beginning to realize, however, that the use of transformers may introduce an error of much greater magnitude than any error inherent in the instruments themselves. In the case of an ammeter or voltmeter, the error introduced by the transformer is simply the error in ratio due to the regulation of the transformer at the particular load of the instruments, relays, etc., which it carries. The ratio can be corrected for any particular load, but since standard transformers are designed to meet a wide diversity of conditions, an absolutely correct ratio is seldom realized. The ratio is further affected in the case of a potential transformer by variations in the primary voltage, and in the case of a current transformer by variations in the primary curent.


Lag
E_S
B
E_P
E_{SR}
ϕ
ϕ-B
I
E_P = Primary Voltage ; E_S = Secondary Voltage, E_{SR} = Reversed Secondary Voltage; I = Line Current; ϕ = Angle of Lag of Line Current; B = Phase Angle of Transformer.
Lag
I_S
E
ϕ
ϕ-B
B
I_{SR}
I_P
I_P = Primary Current ; I_S = Secondary Current, I_{SR} = Reversed Secondary Current, E = Line Voltage ; ϕ = Angle of Lag of Line Current; B = Phase Angle of Transformer.

FIGS. 1 AND 2—VECTOR DIAGRAMS FOR A ONE-TO-ONE RATIO POTENTIAL AND CURRENT TRANSFORMER

When wattmeters or watt-hour meters are involved, there is another error introduced by the phase angle of the instrument transformers; that is, the angle of phase displacement between the primary and reversed secondary voltage or current, as the case may be. This error is often of more consequence than the error in ratio. It is the aim of the writer, therefore, to show the effect of the instrument transformer phase angle on the reading of the meter, and to develop a simple method of calculating this error.

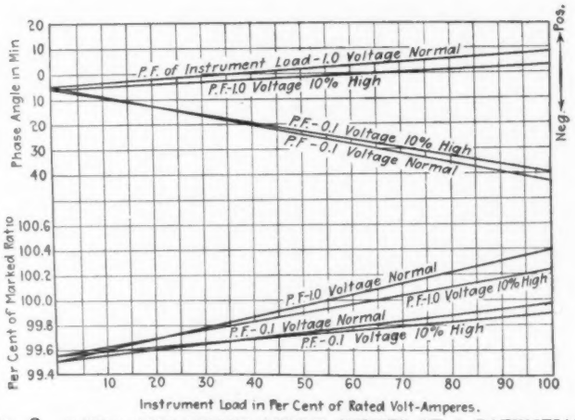


FIG. 3—RATIO AND PHASE-ANGLE CURVES OF A POTENTIAL TRANSFORMER

The phase relations of the primary and secondary of potential and current transformers are shown vectorially in Figs. 1 and 2. In this article we shall consider as positive a phase angle which causes the meter to run fast, and as negative one which causes the meter to run slow, on a circuit of lagging current. This means that in the case of a potential transformer the phase angle is positive when the reversed secondary voltage lags behind the primary, and in the case of a current transformer the phase angle is positive when the reversed secondary current leads the primary. In the case of leading current the error introduced will be of sign opposite that of the phase angle. Reference will also be made to ratio error, and to total error as positive when it causes the meter to run fast and as negative when it causes the meter to run slow.

Typical ratio and phase-angle curves are shown in

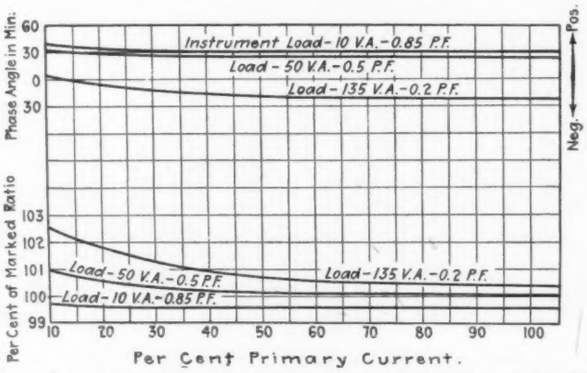


FIG. 4—RATIO AND PHASE-ANGLE CURVES OF A CURRENT TRANSFORMER AT SIXTY CYCLES

TABLE I—VALUES OF k AND PER CENT ERROR AT VARIOUS PHASE ANGLES AND POWER-FACTORS, CALCULATED FROM FORMULA, $E=kB$. B MAY BE POSITIVE OR NEGATIVE, WITH CORRESPONDING SIGN FOR E

Power-Factor	k	Phase Angles					
		20 Min.	1 Deg.	1 Deg. 30 Min.	2 Deg.	3 Deg.	4 Deg.
0.10	0.2894	5.79	17.36	26.05	34.72	52.09	69.45
0.15	0.1917	3.83	11.50	17.25	23.00	34.51	46.01
0.20	0.1425	2.85	8.55	12.82	17.10	25.65	34.20
0.25	0.1126	2.25	6.76	10.13	13.51	20.27	27.02
0.30	0.0925	1.85	5.55	8.33	11.10	16.65	22.20
0.35	0.0778	1.56	4.67	7.00	9.34	14.00	18.67
0.40	0.0667	1.33	4.00	6.00	8.00	12.00	16.01
0.45	0.0577	1.15	3.46	5.19	6.92	10.39	13.85
0.50	0.0504	1.01	3.02	4.54	6.05	9.07	12.10
0.55	0.0442	0.88	2.65	3.98	5.30	7.96	10.61
0.60	0.0388	0.78	2.33	3.49	4.66	6.98	9.31
0.65	0.0340	0.68	2.04	3.06	4.08	6.12	8.16
0.70	0.0296	0.59	1.78	2.66	3.55	5.33	7.10
0.75	0.0256	0.51	1.54	2.30	3.07	4.61	6.14
0.80	0.0219	0.44	1.31	1.97	2.63	3.94	5.26
0.85	0.0181	0.36	1.09	1.63	2.17	3.26	4.34
0.90	0.0141	0.28	0.85	1.27	1.69	2.54	3.38
0.95	0.0096	0.19	0.58	0.86	1.15	1.73	2.30

TABLE II—PER CENT ERROR AT VARIOUS PHASE ANGLES AND POWER-FACTORS COMPUTED EXACTLY. PHASE ANGLES ARE POSITIVE AND ALL VALUES IN THE TABLE ARE POSITIVE

Power-Factor	Phase Angles					
	20 Min.	1 Deg.	1 Deg. 30 Min	2 Deg.	3 Deg.	4 Deg.
0.1	5.79	17.35	26.01	34.66	51.94	69.16
0.15	3.83	11.49	17.22	22.94	34.36	45.73
0.2	2.84	8.53	12.79	17.03	25.59	33.93
0.25	2.25	6.74	10.10	13.46	20.13	26.77
0.3	1.85	5.54	8.29	11.04	16.51	21.94
0.35	1.56	4.66	6.97	9.28	13.87	18.43
0.4	1.33	3.99	5.97	7.94	11.86	15.74
0.45	1.15	3.45	5.16	6.86	10.25	13.60
0.5	1.01	3.01	4.50	5.98	8.93	11.84
0.55	0.88	2.64	3.94	5.24	7.87	10.35
0.6	0.78	2.31	3.46	4.59	6.84	9.06
0.65	0.68	2.02	3.03	4.02	5.98	7.91
0.7	0.59	1.76	2.63	3.50	5.20	6.87
0.75	0.51	1.52	2.26	3.02	4.48	5.91
0.8	0.44	1.27	1.94	2.56	3.81	4.99
0.85	0.36	1.07	1.59	2.10	3.11	4.08
0.9	0.28	0.83	1.23	1.63	2.40	3.13
0.95	0.19	0.56	0.83	1.09	1.58	2.05

Figs. 3 and 4. This is the form in which information regarding the accuracy of instrument transformers is usually furnished by the manufacturers. The problem presented is to convert this information into an expression of error as a percentage of the total energy that should be registered. It is obvious that the percentage of error in the meter due to the ratio error of the transformer is the same as the percentage error in ratio, and nothing further need be said on this point. The error due to the phase angle is more complex, as it is caused by the alteration of the power-factor of the energy registered in the meter from the true power-factor of the circuit. It varies considerably with the power-factor, reaching startling figures at low power-factors and being practically negligible at unity. The phase-angle error at unity power-factor is only 0.24 per cent for a phase angle of 4 deg., which is a much larger angle than is ever reached in a good transformer.

In the case of an instrument transformer of phase angle B, operating on a circuit of power-factor F, the angle φ, whose cosine is F, may be found from a table of natural functions. This will be the angle between the voltage and current of the circuit. Assuming a lagging current, it is obvious that the angle between voltage and current at the meter is $(\varphi - B)$ with proper regard to the sign of the angle B. Since the energy registered is proportional to the power-factor, the error E expressed in per cent as caused by the phase angle is

$$E = [(\cos(\varphi - B) - F) \div F] \times 100 \qquad (1)$$

The total error caused by the transformer is the algebraic sum of the ratio and phase-angle errors. If a potential and a current transformer are both used, the total error is the algebraic sum of the errors of the two transformers.

This is the exact method of computing error due to phase angle, but a simpler method, which does not involve trigonometric functions, gives results which closely approximate true values, and which are accurate enough for most practical purposes.

In Fig. 5 the percentage of error at various power-factors is plotted against phase angle, and it is seen that the curves are nearly straight lines. This indicates that, at a given power-factor, the percentage of error is very nearly equal to the phase angle multiplied by a constant. The assumption may be verified by observing that over a range of 8 deg. (phase angle of ± 4 deg.) the change in cosine between successive minutes is nearly constant. Then,

$$E = kB, \qquad (2)$$

where E is the error in per cent, k is a constant depending on the power-factor, and B is the phase angle expressed in minutes. Values of k for power-factors

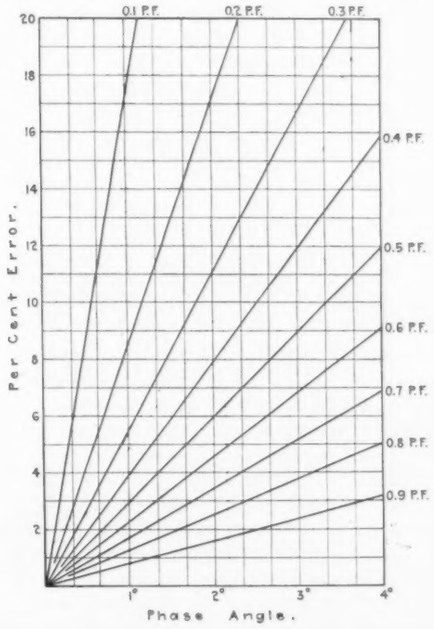


FIG. 5—PER CENT ERRORS AT VARIOUS POWER-FACTORS AND PHASE ANGLES

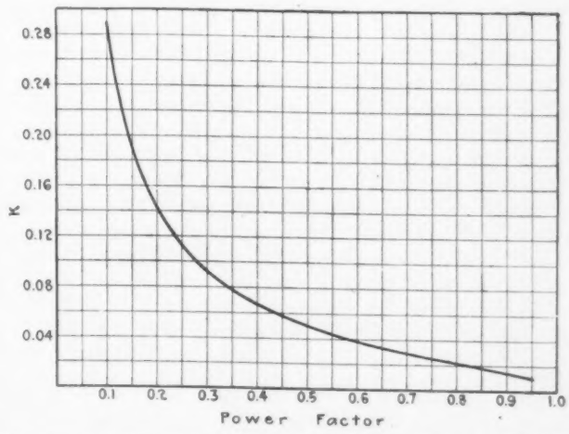


FIG. 6—VALUES OF k FOR EQUATION NO. 2, SHOWING INCREASE IN ERROR WITH DECREASE IN POWER-FACTOR

TABLE III—SAME AS TABLE II, EXCEPT THAT PHASE ANGLES ARE NEGATIVE AND ALL VALUES IN THE TABLE ARE NEGATIVE

Power-Factor	Phase Angles					
	20 Min.	1 Deg.	1 Deg. 30 Min.	2 Deg.	3 Deg.	4 Deg.
0.10	5.79	17.38	26.08	34 79	52.21	69.65
0.15	3.83	11.52	17.29	23.06	34.63	46.22
0.20	2.85	8.56	12.86	17.16	25.78	34.42
0.25	2.25	6.78	10.17	13.58	20.41	27 26
0.30	1.85	5.56	8.36	11.16	16.78	22.42
0.35	1.56	4.69	7.04	9.40	14.14	18.91
0.40	1.34	3.99	6.03	8.06	12.13	16.23
0.45	1.16	3.48	5.23	6.99	10.52	14 09
0.50	1.01	3.04	4.57	6.11	9.20	12.33
0.55	0.88	2.66	4.01	5.36	8.08	10.84
0.60	0.78	2.34	3.52	4.71	7.12	9.54
0.65	0.68	2.06	3.09	4.14	6.22	8.40
0.70	0.60	1.80	2.70	3.62	5.48	7.35
0.75	0.51	1.57	2.34	3.14	4.75	6.39
0.80	0.44	1.32	2.00	2.68	4.06	5.45
0.85	0.36	1.10	1.66	2.22	3.38	4.57
0.90	0.28	0.85	1.30	1.75	2.67	3.62
0.95	0.19	0.59	0.89	1.21	1.86	2.53

of 0.1 to 0.95 are given in Table I. For power-factors between these given, k may be found by interpolation. In Fig. 6 these values of k are plotted against power-factor, showing graphically the rapid increase in error with decrease in power-factor.

In order to show clearly how close is the approximation involved in the use of the above formula, Tables I, II and III have been prepared, comparing the results of calculations by formula with the results of exact computations for both positive and negative phase angles. In Table IV are shown the errors introduced by two different pairs of transformers, illustrating the difference that may be found in the accuracy of transformers of different makes operating under the same conditions.

TABLE IV—ERRORS ACTUALLY OBSERVED IN TWO SETS OF COMMERCIAL TRANSFORMERS

Line load, 10 per cent of rating; single-phase; frequency, sixty cycles; power-factor, 0.8; current, lagging; potential transformer load, 25 volt-amp. at 0.1 power-factor; current transformer load, 50 volt-amp. at 0.5 power-factor.

	Outfit No. 1	Outfit No. 2
Potential transformer:		
Ratio error, per cent	+ 0.25	+ 0.78
Phase angle, minutes	−24	−4¢
Phase-angle error, per cent	− 0.50	− 1.01
Total error, per cent	− 0.25	− 0.23
Current transformer:		
Ratio error, per cent	− 1.05	− 8.3
Phase angle, minutes	+48	+21
Phase-angle error, per cent	+ 1.06	+ 0.46
Total error, per cent	+ 0.01	− 7.84
Total error due to both transformers, per cent	− 0.24	− 8.07

Correcting for errors is at best an uncertain proposition. The central-station engineer should know in advance the accuracy of the transformers he is purchasing. The best transformer is not necessarily the one which shows the least error under one set of conditions, but the one which shows the smallest variation under the variety of conditions met in service.

Conditions Governing Operation of Prime Movers

The Effect on the Economical Performance of Steam Engines and Turbines Resulting from Changes in Steam Pressure, Superheat and Vacuum

BY A. A. POTTER* AND S. L. SIMMERING†

IN order to determine the effect of varying the initial steam pressure on the economy of steam prime movers, including reciprocating engines and turbines, and under otherwise ideal conditions, the accompanying table has been calculated. This table shows the minimum theoretical steam consumption for condensing as well as for non-condensing perfect steam prime movers using dry saturated steam and steam pressures varying from 80 lb. to 200 lb. per square inch absolute. The relations between initial steam pressure and the steam consumption are clearly shown in the accompanying diagram.

From the table and diagram it is evident that the effect of changing initial steam pressure is much more marked in the case of non-condensing than in the case of condensing steam prime movers. The theoretical gain is about 11 per cent when the steam pressure is increased from 80 lb. to 100 lb., 9 per cent when the steam pressure is changed from 100 lb. to 120 lb., and only about 4 per cent when the increase in the initial steam pressure is from 180 lb. to 200 lb. per square inch absolute. Condensing units show that little gain can be expected from using steam pressures above 160 lb. per square inch. The effect of increasing the steam pressure of a condensing engine from 160 lb. to 180 lb. is only about 1.5 per cent.

Actual tests on steam prime movers show that little gain can be expected from increasing the initial steam pressure above 175 lb., the gain being much less for superheated than for saturated steam. In general, the practical limit to high pressures is mainly one of expense. The first cost and the cost of upkeep of steam-power-plant equipment increases with the initial steam pressure. At the same time, however, high pressures decrease the reliability insurance of the steam boiler, engine and piping system.

Simple reciprocating engines are operated at initial steam pressures varying from 80 lb. to 150 lb. per square inch, compound engines at pressures of 120 lb. to 180 lb., and steam turbines at pressures of 120 lb. to 200 lb. per square inch. The gain in economy produced by carrying pressures above 180 lb. does not usually compensate for the expense incurred.

Effects of Superheated Steam

Superheated steam increases the economy of reciprocating engines by decreasing or even eliminating the losses due to initial condensation. The temperature of the cylinder walls as the steam is being admitted at the beginning of the stroke is considerably less than the temperature of the steam. If the steam is saturated, it is partly condensed, giving up heat to the cylinder walls during expansion until the temperature of the steam falls below that of the metal in contact with the steam. When the expansion of the steam lowers its temperature below that of the cylinder walls, heat is given up by the walls, re-evaporating a part of the moisture. This re-evaporation process occurs too late in the expansion, and the heat thus given up by the walls leaves the cylinder with the exhaust steam, producing no useful work. The losses due to condensation and re-evaporation will therefore decrease the efficiency of a reciprocating engine 10 to 25 per cent. With the in-

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coming steam superheated about 100 deg. Fahr., the temperature of the cylinder walls can be heated without condensing the steam, as superheated steam will give up considerable heat before it will become saturated.

In the case of steam turbines, superheated steam affects the economy by decreasing the rotation losses,

THEORETICAL STEAM CONSUMPTION OF STEAM ENGINES

Pressure, Lb. per Sq. In. Abs.	Non-Condensing Back Pressure, 14.7 Lb. Abs.	Condensing Condenser Pressure, 0.5-In. Mercury
80	20.5	7.43
90	19.2	7.28
100	18.2	7.16
110	17.3	7.04
120	16.6	6.97
130	16.1	6.85
140	15.5	6.79
150	15.1	6.71
160	14.7	6.64
180	14.0	6.53
200	13.4	6.43

the surface friction of the rotating element of a turbine being proportional to the density of the steam. In both reciprocating engines and turbines there is also a thermodynamic gain due to the higher temperature and to the greater amount of heat per unit weight of steam. The steam economy resulting from the use of superheated steam is probably greater for reciprocating steam engines than it is for steam turbines. In the case of turbines the use of superheated steam prevents the erosion of the blades which occurs when wet saturated steam is used.

With superheated steam the high temperatures cause rapid deterioration of superheaters and increase the difficulties with piping and fittings. In reciprocating engines the cylinder lubricating oil must be carefully selected, as the lubrication of valves and piston is more difficult and greater allowance must also be made for expansion and contraction of the piping system—factors which add to the maintenance cost of a power-plant operated with superheated steam. With steam turbines the absence of valves and pistons decreases the difficulties with superheated steam, but the deterioration of superheaters and the difficulty with piping systems remain to be combated in all forms of steam prime movers.

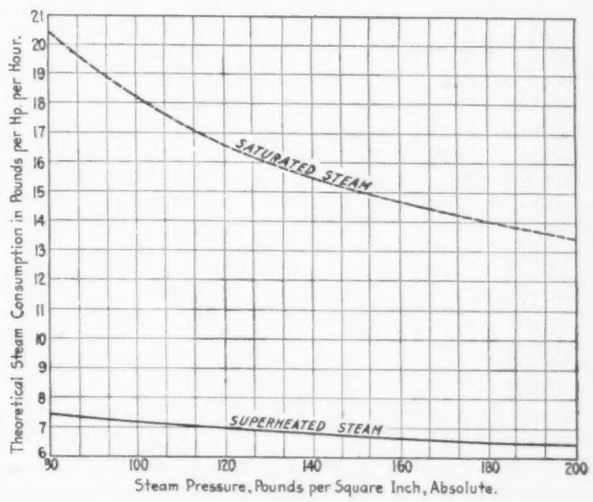
The superheats used in steam-power-plant practice vary from 50 deg. to 200 deg. Fahr. Gains due to superheats in excess of 150 deg. Fahr. are usually obtained at too great a maintenance cost to warrant such practice. The gain in economy due to superheating may be taken as 10 per cent for the first 100 deg. Fahr. and 4 per cent additional when steam is superheated from 100 deg. to 150 deg. Fahr. To superheat steam 100 deg. Fahr. requires 5 to 6 per cent additional fuel, leaving a net commercial gain of 4 to 5 per cent per 100 deg. Fahr. superheat, within the practicable limits of superheating.

Maximum Efficiency for a Heat Engine

The maximum efficiency possible for any heat engine is expressed by $(T_1 - T_2) \div T_1$, in which T_1 is the absolute temperature at which the steam is received and T_2 is the absolute temperature at which the steam is discharged. The greater the difference between the initial and final temperatures, the greater is the ideal efficiency. One method of increasing this difference is by decreasing the exhaust pressure and thereby decreasing the temperature T_2. Calculations made by the equation $(T_1 - T_2) \div T_1$ show that a decrease in the back pressure from a 20-in. to a 21-in. vacuum adds only about 3 per cent to the efficiency of the ideal steam engine, while an increase of the vacuum from a 28-in. to a 29-in. vacuum increases the efficiency by about 15 per cent. This is made possible from the fact that the temperature drop, according to the steam tables, in the first case is 5 deg. Fahr., while in the second case it is 22 deg. Fahr.

All types of prime movers are not capable of utilizing very low back pressures. As a general rule for ordinary reciprocating steam engines a vacuum greater than 26 in. is not desirable, on account of the increased cylinder volume and greater losses due to the condensation and re-evaporation phenomena. On the other hand, in steam-turbine work, where greater ratios of expansion are possible without alternating heating and cooling of metal surfaces, the greatest benefit is derived from the use of very low back pressures. A pound of steam at a pressure of 1.5 lb. absolute, corresponding to a 27-in. vacuum, has a volume of 231.8 cu. ft. and a temperature of 115 deg. Fahr. Under these conditions 1027 B.t.u. must be abstracted from each pound of steam to cause it to condense. Approximately 51.4 lb. of water must be heated through a temperature range of 20 deg. Fahr., or 20.5 lb. through 50 deg. Fahr.

The presence of air within the condenser has a marked influence on its operation. According to Dalton's law, a constant weight of gas at a constant temperature and volume exerts the same pressure upon the walls of the containing vessel regardless of any other gas or vapor being present. If the temperature at some point in the condenser is 101.5 deg. Fahr., the pressure exerted by the water vapor is 1 lb. per square inch, while the total pressure within the condenser may be 1.5 lb. per square inch. The additional 0.5 lb. pressure is due to the presence of air. If the temperature of the mixture of air and vapor at the suction valve of the air pump is 60 deg. Fahr., the weight of a cubic foot of steam at this pressure is 0.000828 lb. and the corresponding pressure is 0.25 lb. The partial pressure of the air is then 1.25 lb., and each cubic foot of the mixture will contain 0.00645 lb. of air. It is evident from



RELATION BETWEEN INITIAL STEAM PRESSURE AND STEAM CONSUMPTION

the above that the capacity of an air pump is determined by the number of pounds of air that enter the condenser and the temperature and pressure at which the mixture is withdrawn. To secure a high vacuum requires the use of great quantities of water to absorb the latent heat when condensing the steam and also to cool the air to as low a degree of temperature as possible.

Gain in Economy Due to Increasing Vacuum

The gain in economy which can be expected by increasing the vacuum depends to some extent upon the size of the engine or turbine, and also upon the type of machine. The theoretical gain for a perfect steam prime mover per inch of vacuum will vary from about 3.0 per cent at 25 in. vacuum to about 5.0 per cent at 28 in. vacuum. This shows that increasing the vacuum of a perfect steam prime mover is more effective than increasing the steam pressure. (Compare results given in the table.) The actual gain per inch of vacuum in the case of impulse steam turbines of the Curtis type varies from about 4 per cent at a vacuum of 25 in. to about 5 per cent at a vacuum of 28 in., all referred to a 30-in. barometer. A well-designed steam turbine will very nearly realize the theoretical gains for any given vacuum. Action and reaction turbines of the Parsons type will show a gain per inch of vacuum of about 3 per cent for vacuums varying from 25 in. to 28 in.

Reciprocating engines will usually operate more economically than steam turbines when the vacuums are lower than 26 in. For higher vacuums the steam turbine gains rapidly. Very high vacuums when applied to reciprocating engines increase beyond practical limits the sizes of valves and ports. Reference to a steam table will illustrate this fact. Thus at a vacuum of 26 in., which corresponds to 1.96 lb. absolute, the volume of 1 lb. of steam is 177 cu. ft. If the vacuum is increased to 28 in., the volume per pound becomes 341 cu. ft., and at 29 in. vacuum the volume of 1 lb. of steam reaches the enormous value of 657 cu. ft.

Steam turbines present no difficulties on account of the increased volume of steam at high vacuums. Vacuums 28 in. and higher are carried in steam-turbine power plants. To maintain such vacuums requires expensive condensing equipment and a large supply of cooling water at fairly low temperatures. In the case of low-pressure steam turbines operating under an initial pressure slightly above atmospheric, high vacuums are absolutely necessary. A 1-in. change of vacuum in the case of a low-pressure steam turbine between 26 in. and 28 in. will affect the economy at least 10 per cent.

When considering gain in steam consumption on account of high vacuum, attention must also be given to the fact that a high vacuum means a low temperature of the condensed steam and may necessitate heating of the condensed steam before it is returned to the boiler. A condenser to carry a high vacuum should be designed with sufficient cooling surface. Two to four square feet of cooling surface per kilowatt rating of prime mover will usually be necessary to maintain high vacuums in steam-turbine plants.

Construction Costs for a 10,000-Kw. Steam Plant

Data Showing Entire and Unit Costs Due to Station Buildings, Land and Equipment, Together with Construction Items Under Each Heading

THE largest generating station of the Bay State Street Railway is at Quincy Point, Mass. Five 2000-kw. turbo-alternators are in use, and the plant carries a large part of the load on the southern lines of the system. In connection with the proceedings of the company before the Massachusetts Public Service Commission on behalf of a fare increase, the consulting engineers of the road, Sloan, Huddle, Feustel & Freeman of Madison, Wis., have filed a detailed schedule of the investment costs for this station to Nov. 1, 1914, based on an exhaustive study of the company's records. Some of the information and data of an engineering nature that show unit costs are presented in the following tables. The total cost of buildings, land and equipment is shown in Table I, together with the cost per kilowatt.

TABLE I—COST OF QUINCY POINT STATION AND EQUIPMENT

	Cost	Per Kw.
Building and structures	$308,210	$30.820
Land	149,850	14.985
Equipment	841,786	84.178
Grand total cost, station proper	$1,299,846	$129.983

The station is on tidewater, a brick and steel structure, 121 ft. by 161 ft., supported by extensive concrete foundations, made necessary by very poor soil conditions. The floors are of plain or reinforced concrete, the roof being of reinforced concrete supported by steel trusses and covered with tar and gravel. The cornice work and flashings are of copper, door and window frames also being copper-covered. Coal is delivered to the plant by barge and unloaded by a stationary hoisting tower and a continuous line cable road on a wooden trestle, together with a steel transfer and reclaiming bridge. A reinforced-concrete tunnel connects the coal pocket with the boiler room. There are ten water-tube boilers, mechanical stokers, a forced-draft blower system, two 125-ft. stacks, and surface condensing equipment. The station began operation about twelve years ago and has been well maintained since. A local 2250-kw. rotary-converter substation is also included.

TABLE II—BUILDING AND ACCOMPANYING COSTS FOR QUINCY POINT STATION

Structure	Cost	Cost per Kw.
Power house	$176,368	$17.636
Building, piping and regulator system	4,064	0.406
Suction and discharge wells in building	4,514	0.451
Housing, tracks and hoppers	5,054	0.505
Battery-house addition	2,635	0.263
Custodis chimney, No. 1	10,700	1.070
Custodis chimney, No. 2	7,466	0.746
Flues	9,255	0.925
Coal-conveyor tunnel	12,458	1.245
Intake crib	7,339	0.733
Suction sewer	4,898	0.489
Discharge sewer	4,656	0.465
Concrete tank	2,216	0.221
Coal trestle	13,128	1.312
Hoisting tower	1,080	0.108
Fence	1,076	0.107
Gear house	268	0.026
Motor house	342	0.034
Tower house	713	0.071
Scale shed	127	0.012
Hoist shed	245	0.024
Crusher shed	388	0.038
Hydrant houses, shed and fence	189	0.018
Total building and structures	$269,179	$26.917
Engineering, interest, insurance, contingencies, 11 per cent.	29,610	2.961
Taxes and organization, 3.5 per cent	9,421	0.942
Grand total, building and structures	$308,210	$30,820
Land (portion required by station)	$138,750	$13.875
Engineering, interest, contingencies, taxes and organization during construction, 8 per cent	11,100	1.110
Grand total, land	$149,850	$14.985

TABLE III—COST OF EQUIPMENT INSTALLED

Item	Quantity	Unit Cost	Total Cost
736-hp. A. & T. water-tube boilers and superheaters	8	$11,597	$92,776
687-hp. B. & W. water-tube boilers and superheaters	2	10,206	20,412
Jones underfeed stokers	16	480	7,680
Taylor gravity underfeed stokers	4	3,740	14,960
Taylor gravity underfeed stokers	2	2,125	4,250
Engine-driven forced-draft blowers	4	1,365	5,460
Foundations for above			2,181
Engine-driven forced-draft blower	1	1,365	1,365
Foundation for above			557
Coal-handling equipment on wharf			20,973
Blake-Denison continuous coal weigher	1	2,860	2,860
McCaslin gravity bucket-conveyor system, with crusher and weigher	1		19,010
Coal chutes above stokers	20	194	3,880
Sump pump, 1-in. vertical motor-driven, centrifugal	1	143	143
Snow duplex, 16-in. by 10-in. by 12-in. feed pumps	3	747	2,241
Foundations for above			675
6-in. by 6-in. by 6-in. Platt duplex-feed pump	1	182	182
Feed-water storage tanks	3	270	810
Foundations for above			162
4500-hp. "National" closed-coil heater	2	2,480	4,960
Foundations for above			109
4500-hp. "National" closed-coil heater	1	2,435	2,435
Foundation for above			54
Station piping			85,186
Pipe covering			6,835
2000-kw. Curtis vertical turbo-generators, with accumulators and step-bearing pumps	5	56,825	284,125
Foundations for above units			9,275
Wheeler surface condensers and motor-driven auxiliaries	4	17,577	70,308
Foundations for above			3,399
Wheeler surface condenser and steam-driven auxiliaries	1	17,371	17,371
Foundations for above			855
10-in. by 16-in. by 18-in. Deane Simplex priming pumps	2	298	596
Foundations for above			135
3-in. vertical motor-driven centrifugal sump pump	1	275	275
3-in. by 2-in. by 3-in. Blake duplex oil pump	1	60	60
Foundation for above			15
Oil receivers and filter for turbines			640
Foundations for above			10
Miscellaneous tanks, filters, etc.			249
75-kw. G. E. engine-driven exciter set	1	4,200	4,200
Foundation for above			183
50-kw. G. E. motor-driven exciter set	1	2,250	2,250
Foundation for above			34
50-kw. G. E. engine-driven exciter set	1	2,800	2,800
Foundation for above			34
50-kw. Sturtevant engine-driven exciter set	1	2,000	2,000
Foundation for above			183
70-cell "chloride" battery			5,000
Foundation for above			47
330-kw. G. E. three-phase air-blast transformers	2	2,512	5,024
75-kw. G. E. three-phase air-blast transformers	1	600	600
13,200-volt G. E. electrolytic lightning-arrester sets	3	343	1,029
Switchboards and wiring			19,261
Testing equipment			1,132
Steel testing tanks	2	100	200
Fairbanks scales	1	111	111
Fairbanks platform scales	1	105	105
30-ton Reading hand-operated crane	1	2,085	2,085
16-in. by 6-in. screw-cutting engine lathe	1	565	565
32-in. Blaisdell upright drill press	1	260	260
22-in. by 22-in. by 6-ft. Wheeler planer	1	566	566
No. 5 Blount tool grinder	1	50	50
18-in. motor-driven pipe-threading machine	1	893	893
15-hp. G. E. direct-current shop motor	1	264	264
Shafting, belting and pulleys in shop			277
Miscellaneous equipment and tools			1,787
Total			$738,409
Engineering, interest, insurance and contingencies during construction, 10.5 per cent			77,533
Taxes and organization, 3.5 per cent			25,844
Grand total			$841,786
Equipment cost per kilowatt of station capacity			$84.178

TABLE IV—DETAILED COSTS OF QUINCY POWER STATION (10,000-KW. RATING)

Item	Quantity	Unit Cost	Total Cost
Excavation, cu. yd.	17,618	$2.00	$35,236
Concrete:			
Foundations, cu. yd.	2,114	10.00	21,140
Walls, cu. yd.	58	12.00	696
6-in. floor, reinforced, sq. ft.	12,339	0.52	6,416
5-in. floor, reinforced, sq. ft.	1,800	0.49	882
4-in. floor, reinforced, sq. ft.	319	0.42	134
1-in. floor, reinforced, sq. ft.	297	0.75	223
Floors, reinforced, cu. yd.	5	12.00	60
Roof, reinforced, sq. ft.	18,330	0.47	8,615
6-in. floor, plain, sq. ft.	12,588	0.22	2,769
Cut stone:			
Rough, cu. ft.	561	1.50	842
Plain, cu. ft.	1,170	2.00	2,340
Brick walls, per M.	1,216	22.00	26,752
Brick arches, per M.	39	40.00	1,560
Millwork:			
Doors, sq. ft.	1,173	.....	1,607
Windows, sq. ft.	8,931	.....	15,622
Steel:			
Columns, lb.	180,573	0.04	7,223
Plate girders, lb.	145,785	0.06	8,747
Beams, lb.	302,765	0.04	12,111
Trusses, lb.	57,590	0.06	3,455
Purlins, lb.	98,175	0.04	3,927
Bracing, lb.	6,091	0.04	244
Cast iron, lb.	147,632	$0.03	$4,429
Stairways, railings, etc., lb.	42,863	0.06	2,572
Miscellaneous iron work	.....	.....	184
Sheet metal	.....	.....	2,859
Drains	.....	.....	661
Electric lighting	.....	.....	2,266
Painting:			
Oil, sq. yd.	930	0.18	167
Cold water, sq. yd.	7,934	0.12	952
Plumbing	.....	.....	1,677
Total			$176,368
Building piping			$1,878
Johnson regulator system			2,186
Total			$4,064
Suction and discharge wells in building:			
Excavation, cu. yd.	826	2.00	$1,652
Concrete, cu. yd.	36	10.00	360
Brick, per M.	94	24.00	2,256
20-in. vitrified pipe, ft.	176	1.40	246
Total			$4,514
Housing on boiler-room roof			$36
Ash-handling tracks			338
Coal and ash hoppers			4,680
Total			$5,054
Battery-house addition, erected in 1912 to house storage-battery equipment (this is of the same general type as the main building and is in good condition):			
Excavation, cu. yd.	39	0.75	$29
Concrete:			
Foundations, cu. yd.	56	7.00	392
4-in. floors, sq. ft.	917	0.16	147
7-in. roof, sq. ft.	917	0.50	458
Brick, per M.	26	20.00	520
Timber:			
Framing, M bd. ft.	0.2	45.00	9
Sheathing, M bd. ft.	0.5	60.00	30
Roofing tar and gravel, sq. ft.	966	0.06	58
Cement coping, cu. ft.	21	0.40	8
Millwork:			
Doors, sq. ft.	54		30
Windows, sq. ft.	72		43
Shutters, sq. ft.	112		112
Ventilators	9		62
Painting, cold water, sq. yd.	274	0.12	33
Varnishing, sq. yd.	59	0.25	15
Steel, lb.	31,050	0.02	621
Total			$2,635
Custodis chimneys, 125 ft. high, 12 ft. inside diameter:			
Chimney No. 1:			
Piles, lin. ft.	3,000	0.40	$1,200
Excavation, cu. yd.	500	2.00	1,000
Concrete, cu. yd.	285	10.00	2,850
Brick:			
Common, per M.	129	24.00	3,096
Fire, cu. ft.	336	0.60	202
Custodis, cu. ft.	4,200	0.50	2,100
Ladder			122
Lightning rod			130
Total			$10,700
Chimney No. 2:			
Excavation, cu. yd.	233	2.00	$466
Concrete, cu. yd.	135	10.00	1,350
Brick:			
Common, per M.	129	24.00	3,096
Fire, cu. ft.	336	0.60	202
Custodis, cu. ft.	4,200	0.50	2,100
Ladder			122
Lightning rod			130
Total			$7,466
Flues:			
Concrete coping, cu. ft.	50	0.35	$18
Brick on steel angles, per M.	18	24.00	432
Steel angles, lb.	22,803	0.04	912
Sheet iron, lb.	92,200	0.065	5,993
Asbestos covering, sq. ft.	12,039		1,900
Total			$9,255
Coal-conveyor tunnel:			
Excavation, cu. yd.	1,187	2.00	$2,374
Sheet piling, M bd. ft.	12	60.00	720
Brick, per M.	87	26.00	2,262
Concrete:			
Walls, plain, cu. yd.	370	10.00	3,700
5-in. roof, reinforced, sq. ft.	936	0.45	421
6-in. roof, reinforced, sq. ft.	521	0.50	260
9-in. roof, reinforced, sq. ft.	546	0.75	410
6-in. floor, sq. ft.	2,192	0.25	548
Sand cushion, cu. yd.	44	2.00	88
Waterproofing, sq. ft.	4,992	0.06	300
Timber, M bd. ft.	1.4	60.00	84
Steel beams, lb.	26,544	0.04	1,062
Steel ladders, etc., lb.	492	0.08	39
Electric lighting			73
Painting, cold water, sq. yd.	438	0.18	79
Base for motor			38
Total			$12,458
Intake crib:			
Excavation, cu. yd.	254	$3.00	$76
Concrete:			
Mat, reinforced, cu. yd.	188	10.00	1,880
Walls, reinforced, cu. yd.	198	16.00	3,168
Timber:			
[illegible]ing, M bd. ft.	0.6	45.00	27
S[illegible]ng, M bd. ft.	1.6	50.00	80
Stee[illegible]	8,308	0.08	665
Float[illegible]			40
Screens	956	0.75	717
Total			$7,339

Item	Quantity	Unit Cost	Total Cost
Suction sewer:			
Excavation, cu. yd.	904	$3.00	$2,712
Sheet piling, M bd. ft.	6.4	60.00	384
Timber:			
Sills, M bd. ft.	1.6	50.00	80
Floor, M bd. ft.	1.7	60.00	102
Concrete, cu. yd.	82	15.00	1,230
Brick, per M	13	30.00	390
Total			$4,898
Discharge sewer:			
Materials, labor and unit cost virtually same as suction sewer			$4,656
Concrete tank:			
Excavation, cu. yd.	440	0.60	$264
Concrete:			
Walls, cu. yd.	86	12.00	1,032
Floor, cu. yd.	92	10.00	920
Total			$2,216
Coal trestle:			
Excavation, cu. yd.	407	2.50	$1,018
Piles, ft.	4,160	0.60	2,496
Concrete, cu. yd.	166	20.00	3,320
Timber, framing, M bd. ft.	82	70.00	5,740
Steel, braces, lb.	2,715	0.04	109
Steel track:			
Heavy, 5-in., tons	2.6	40.00	104
Light, 2.5 in., lb.	8,000	0.04	320
Steel trestle, lb	348	0.06	21
Total			$13,128
Hoisting tower:			
Timber, framing, M bd. ft.	18	60.00	$1,080
Fence			1,076
Total			$2,156
Gear house:			
Timber:			
Framing, M bd. ft.	2.7	60.00	$162
Wall sheathing, M bd. ft.	0.6	60.00	36
Roof sheathing, M bd. ft.	0.3	60.00	18
Millwork:			
Doors, sq. ft.	16		6
Windows, sq. ft.	33		15
Tar paper, sq. ft.	303	0.03	9
Electric lights			22
Total			$268
Motor house:			
Timber:			
Framing, M bd. ft.	0.2	60.00	$14
Wall sheathing, M bd. ft.	0.4	60.00	22
Roof sheathing, M bd. ft.	0.1	60.00	6
Platform, M bd. ft.	4.6	60.00	276
Millwork:			
Doors, sq. ft.	16		6
Windows, sq. ft.	17		8
Painting, sq. yd.	58	0.18	10
Total			$342
Tower house:			
Timber:			
Framing, M bd. ft.	1.8	60.00	$108
Wall sheathing, M bd. ft.	2.8	60.00	168
Flooring, hard pine, M bd. ft.	0.6	70.00	42
Flooring spruce, M bd. ft.	1.4	60.00	84
Platform, M bd. ft.	2.3	60.00	138
Millwork:			
Windows, sq. ft.	91		41
Doors, sq. ft.	36		13
Painting, sq. yd.	331	0.18	60
Electric lighting			38
Roofing, tar paper, sq. ft.	712	0.03	21
			$713
Scale shed			$127
Hoist shed			245
Crusher shed			388
Hydrant house No. 1			31
Hydrant house No. 2			31
Shed for tank and fence			127

TABLE V—LOCAL SUBSTATION APPARATUS AT QUINCY POINT STATION—ADDITIONAL COST

Item	Quantity	Unit Cost	Total Cost
750-kw. G. E. rotary converters	3	$10,085	$30,255
Foundations for above			56
360-kw. M. G. booster set	1	14,967	14,967
Foundation for above			89
825-kw. G. E. three-phase air-blast transformers.	3	3,872	11,616
70-in. Buffalo blowers, motor-operated	2	365	730
Foundation for above			17
G. E. air-compressor outfit	1	375	375
Switchboards and wiring			8,893
10-ton Reading hand-operated crane	1	1,350	1,350
Total			$68,348
Engineering, interest, insurance, contingencies, 10.5 per cent			7,177
Taxes and organization, 3.5 per cent			2,392
Total Quincy Point substation equipment cost.			$77,917
Substation equipment cost per kilowatt			$34.63

MONTHLY ENERGY COSTS FOR SMALL MANUFACTURING PLANT

Grouping of Motor-Driven Machines—Sizes of Motors Required — Costs per Connected Horsepower of Total Equipment

Interesting figures are shown for monthly energy cost per horsepower of connected load by a Seattle (Wash.) manufacturing plant using motors to drive machines in the various departments. This plant makes a variety of electrical distribution apparatus and accessories, such as panelboards, steel cabinets, large switches, solenoids, battery relays, charging rheostats, plugs, receptacles and the like and operates a sheet-metal department, a plating department, a machine shop and an assembling department. The total connected load in motors distributed throughout the building is 66.35 hp. The distribution of these motors and the machines they drive are shown in the accompanying table. The demand on equipment is so diversified that it is seldom all machines are in operation at one time, which accounts for the reasonable cost per month per horsepower of connected load, as shown in Table I.

The average charge for power per month is $54.52 for the connected load of 66.35 hp., or an average of 82 cents per horsepower of connected load per month. The average charge per kilowatt-hour for energy used is 2.058 cents. In addition to the motor load shown in Table II, a 20-kw. spot-welder is used in the sheet-metal shop. The energy charges tabulated in Table I include the energy consumed by this spot-welder.

TABLE I—MONTHLY ENERGY CONSUMPTION FOR CONNECTED LOAD OF 66.35 HP.

Month	Kilowatt-Hours	Rate, Cents	Total
July, 1914	2,929	1.9	$55.65
August, 1914	3,186	1.8	57.35
September, 1914	2,371	2.3	54.53
October, 1914	2,361	2.3	54.30
November, 1914	2,205	2.4	52.92
December, 1914	2,628	2.1	55.19
January, 1915	2,527	2.2	55.59
February, 1915	2,419	2.2	53.22
March, 1915	2,584	2.1	54.26
April, 1915	2,722	1.9	51.72
May, 1915	2,986	1.8	53.75
June, 1915	3,281	1.7	55.78
Total	32,199		$654.26

These data are taken from records at the plant of the A. G. Electric & Manufacturing Company, Seattle, Wash.

FIG. 1—SHEET-METAL SHOP, SHOWING ELECTRIC SPOT-WELDER AT RIGHT

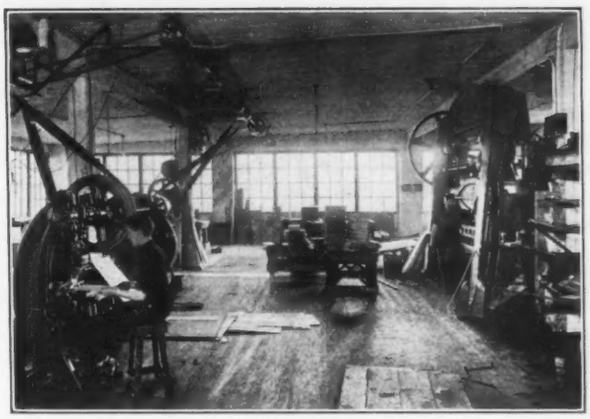


FIG. 2—SHEET-METAL SHOP, SHOWING POWER BENDER AND PUNCH PRESS

Group-drive motors and belt and shaft transmission were considered advisable at this plant since only a few of the machines connected with each motor are required to operate at the same time, thus making it possible to use motors designed for the average load rather than individual motors having a much larger aggregate rating, many of which would be idle most of the time. The use of individual motors may be more satisfactory, however, in cases when the initial investment is offset by the improved appearance due to the absence of shafts, the elimination of belt and shaft friction losses, the flexibility of operation, and the saving in revenue obtained from operating motors at near their rating.

TABLE II—MOTOR-DRIVEN EQUIPMENT IN A SMALL WESTERN MANUFACTURING PLANT

Location	Department	Motor Rating	Machines Driven
Roof.....	.....	One 15-hp.	Elevator
		One 3-hp.	Discharge fan
Third floor..	Plating department	One 0.75-hp.	Plating generator for four plating tanks
		One 1-hp.	One polishing lathe
			One belt-polishing lathe
		One 5-hp.	One polishing lathe
			One plating barrel
		One 2-hp.	One tumbling barrel
	Sheet-metal department	One 3-hp.	One blower
			Two drill presses
			One emery stand
		One 5-hp.	Two punch presses
			One knife shear
			One roll shear
		One 10-hp.	One power bender
Second floor.	Machine shop	One 7.5-hp.	One emery stand
			One miller
			One drill press
			One punch press
			One hack-saw
			One disk grinder
			One bolt machine
			One shaper
			One profiler
			Two universal grinders
			Three lathes
			One riveting machine
		One 5-hp.	Two air pumps
			One screw machine
			One speed lathe
			One four-spindle drill
			One three-spindle drill
			One table saw
			One drill press
			Two grindstones
			One d.c. generator for magnetic chucks
		One 0.1-hp.	One filing machine
	Assembling department	One 3-hp.	One air pump
			One drill press
			One saw grinder
			One tapping machine
			One slate band-saw
		One 3-hp.	One slate saw
			One slate slotter
			One emery stand
			One six-spindle drill
			Three slate drills
			One grindstone
First floor..	Shipping department	One 3-hp.	One cut-off saw

HOW A TRANSMISSION COMPANY PREVENTED TELEPHONE TROUBLES

Substituting Bridging for Series Instruments—Separating Telephone and Power Circuits—Balancing on Long Spans and Providing Drainage Coils

BY F. MAURY GILLESPIE

Some time ago the writer was confronted with the problem of maintaining a satisfactory telephone service over wires strung on poles used for 12 miles of 2200-volt distribution lines. This was accomplished by converting the series instruments in service at the time to bridging apparatus with 1000-ohm ringers, installing suitable carbon spark-gaps and protective fuses at all instruments, and using 1:1 telephone transformers at the most important stations. These transformers were protected by a switch, fuse and lightning arrester supplied by the manufacturer. The wires were transposed at intervals of approximately 600 ft., a high-resistance line wire—No. 12 B. W. G. steel wire—being employed.

Under these conditions service was fair. However, the lines were somewhat noisy under the best of conditions. Grounds on either a power line or its corresponding parallel telephone line rendered the telephones useless until the trouble was removed on account of the excessive humming in the receivers. It was also found that carbon dust would short-circuit or ground a telephone line with the slightest variation from normal operating conditions. While this condition was inconvenient, it did not lead to any serious difficulties, so that no attempt was made to remedy the matter until after a new power plant of 1800-kva. rating was put into operation. This plant is about 10 miles from the point of utilization of power. The transmission voltage is 22,000, energy being transmitted to a step-down station over a double-circuit three-phase line carried on steel poles spaced at intervals approximating 250 ft. The contour of the country is such that spans of 400 ft. to 1200 ft. were possible, and for these spans H frames were used, the same poles being used with the two circuits strung between the two poles, instead of one on a side, as is the case in single-pole construction. Fig. 1

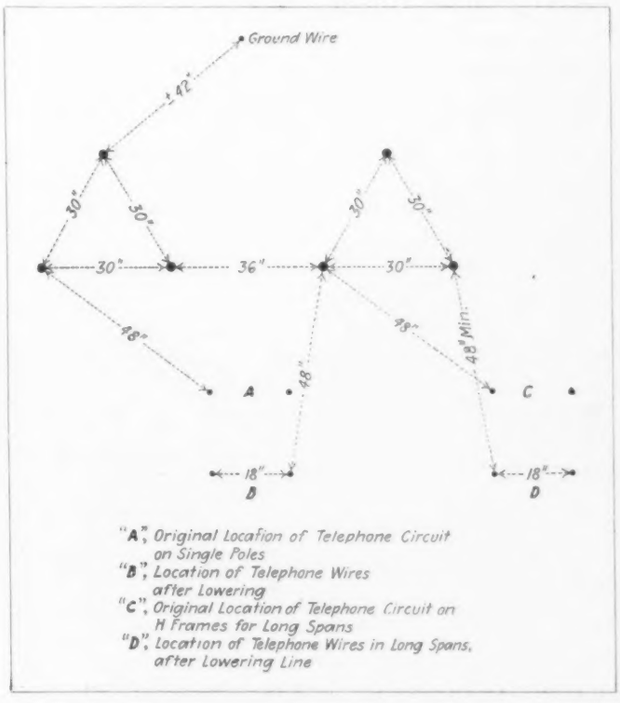


FIG. 1—RELATIVE POSITIONS OF TELEPHONE AND TRANSMISSION LINE CONDUCTORS ON THE SAME POLES

shows the relative positions of the power and telephone wires on this line. Transpositions are at 1200-ft. intervals, and great care was taken to have that part of the line strung to one side of the power lines balance.

On this line the original telephone equipment included the standard 1:1 transformers, insulated for 25,000 volts, with the usual switch, fuse and lightning arrester. When the line voltage reached 15,000 trouble started.

The following were some of the difficulties:

1. Starting or stopping of motors of more than 60 hp. caused the telephone bells to sound.
2. Grounds on either the telephone or power lines rendered the telephone line not only useless but positively dangerous. Even signaling was impossible, as the bells rang continuously as long as the fuses were intact.
3. On very dry days heavy static discharges were noted, generally in the afternoon or early evening.
4. Charging the electrolytic arresters had the same effect that changes of load did; that is, the gongs were caused to ring.
5. The voltage between telephone line and ground was 780, measured by an ordinary switchboard voltmeter connected through a 1000-watt transformer. It is the writer's belief that an electrostatic voltmeter would have given a reading considerably higher than the one obtained.

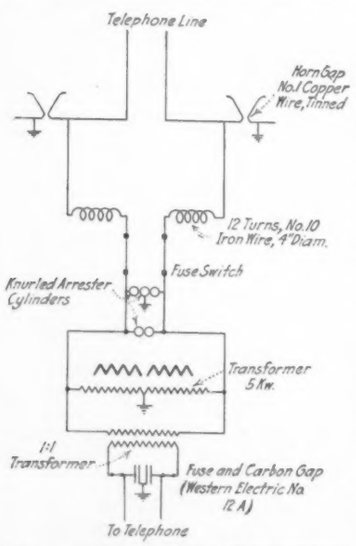
In an attempt to remedy these conditions the telephone line was lowered to give the spacing shown at *B* and *D* in Fig. 1. This caused the following changes in normal conditions:

1. The voltage to ground was reduced to less than 200 volts.
2. Talking was rendered much clearer owing to the reduction of noise in the receivers.
3. Bell ringing due to grounds on telephones and surges in power lines was practically eliminated.

While this arrangement was a great improvement over original conditions, it was still far from perfect. The writer then began to experiment with various types of drainage apparatus, finally adopting as standard the arrangement shown in Fig. 2. This was so satisfactory that those lines that parallel 2000-volt lines were similarly equipped.

For telephone lines carried on poles with 2200-volt power conductors, the horn-gaps shown in Fig. 2 and the choke coils are omitted. A transformer of 1-kva. rating is used instead of a 5-kva. On lines 15,000 ft. to 25,000 ft. long humming in receivers nearest the drainage coil is entirely eliminated and at the far ends of the lines is barely noticeable.

The writer's arrangement is somewhat different from those employed on the system of the Georgia Railway & Power Company and used by other companies as outlined in various published descriptions, and for this reason it is hoped that it will prove of interest to some readers. The arrangement has afforded relief to the extent that grounds on the telephone line do not render the instruments absolutely useless, as was formerly the case, unless both wires are dead-grounded. Furthermore, the lines can be used even with one or more leaky insulators on the power lines, a condition that was impossible before installing the drainage system. The entire protective outfit—fuses, arresters, insulating transformers and drainage coils—is installed out of doors, and no attempt has been made to protect it from rain, although the precipitation in this locality averages over 100 in. in the six-month rainy season and has reached 40 in. in one month.


Telephone Line
Horn Gap No.1 Copper Wire, Tinned
12 Turns, No.10 Iron Wire, 4" Diam.
Fuse Switch
Knurled Arrester Cylinders
Transformer 5 Kw.
1:1 Transformer
Fuse and Carbon Gap (Western Electric No. 12 A)
To Telephone

Transmission line is double circuit, 22,000 volts, 49,000 ft. long. With drainage coils disconnected, the voltage of telephone line to ground with one circuit alive was 70 volts; with both circuits alive, 150 volts. With drainage coils connected all voltage readings are zero. With a horn-gap setting of 0.188-in. the spark-over emf. is 3700 at sixty cycles. With cylinder gap to ground set at 0.063 in. the spark-over emf. is 1200 at sixty cycles. With cylinder gap line-to-line set at 0.01 in. the maximum emf. between lines is 200. The transformer used is rated at 5 kva., 1100-2200 volts primary. The secondary is left open.

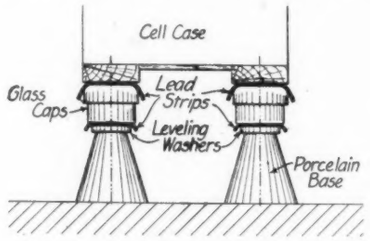
FIG. 2—TELEPHONE-PROTECTION ARRANGEMENTS USING DRAINAGE COILS FOR TELEPHONE LINE CARRIED ON STEEL POLES WITH A TRANSMISSION LINE

Operating Schemes

Two dollars will be paid for each item published giving ideas and data, new or simplified methods and experiences in solving troubles.

Supports for Storage-Battery Cells

The accompanying illustration shows the method employed by the New York Edison Company for supporting standby battery cells. To the bottom of each cell case, along the longer sides, are attached 6-in. wood strips which transfer the weight of the cell to the supports. The latter consist of conical-shaped porcelain bases with glass caps containing oil rings. Between the bases and caps and also between the caps and cell



PORCELAIN BASES WITH GLASS CAPS USED TO SUPPORT BATTERY CELLS

cases crossed strips of lead are placed which serve to distribute the pressure uniformly over the surface of the glass and porcelain. These strips are also employed to make each support take its share of the load and to level the cell cases. With 123-plate cells rated at 9150 amp. on the one-hour discharge rate six insulating supports are employed.

The Use of Electric Horns Instead of Bells for Signaling Purposes

BY HARRY RESTOFSKI

In power houses and substations containing noisy machinery or a number of bells for signaling purposes, it is frequently difficult to recognize signals. A satisfactory method of reducing trouble from this source is by the use of an electric horn instead of a bell.

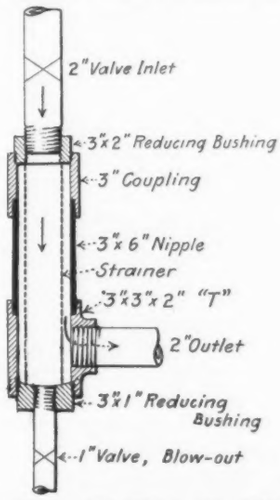
If the horn is used in connection with a telephone, it may be connected in a relay circuit in series with the necessary number of cells or source of energy supply in such a way that when signaling current is impressed on the telephone line the relay is energized and the horn circuit closed by the movement of the relay armature. If the telephone line is a non-selective party line, the

relay armature is constructed to return to its initial position when the energizing current ceases to flow. In this manner usual telephone signals may be sounded as with a bell. For use on a direct line the relay may be constructed to hold its armature in the energized position and thus keep the horn circuit closed until opened by the attendant.

The writer knows of the successful use of an electric horn working on a 110-to-6-volt transformer of a low-water-alarm circuit in a power house, and of still another that is used to notify the firemen that an additional unit is to be started. In the last case a lamp is connected across the primary side of the transformer as an additional signal and to prevent the possibility of confusion with horn signals that may be given later.

A Strainer for Water Line to Transformers

The construction details of a simple water strainer that can be made from standard pipe fittings are shown in the accompanying illustration. Water flows into the top of the galvanized-sheet-iron tube shown, through which 5/32-in. holes are punched from the inside ¾ in. apart before the tube is bent into shape. This leaves the inside smooth so that any trash collected will settle at the bottom and can be blown off through the 1-in. valve.



CONSTRUCTION OF A STRAINER TO REMOVE DIRT FROM TRANSFORMER COOLING WATER

The outer casing is made up of pipe fittings of the dimensions indicated. By unscrewing the lower reducing bushing the strainer may be removed for inspection and cleaning.

This device has been successfully used by R. H. Lewis, Sylvan, Minn., in the water line leading to a 1000-kw. bank of transformers.

Use of Sulphur in Bushing Filler of Oil-Cooled Transformers

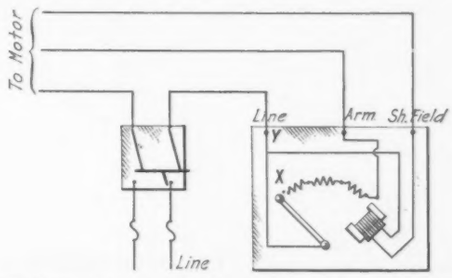
BY EDWARD J. HUNT

The method of sealing transformer leads and preventing the siphoning of oil described by A. C. Hewitt on page 1091 of the Nov. 13 issue of the ELECTRICAL WORLD, wherein a mixture of sulphur and plaster of paris is used, may be dangerous to the life of transformers. In pouring the mixture into place as suggested by Mr. Hewitt it may be spilled into the transformer tank and come into contact with the oil. Although the mixture may be impervious to transformer oil, when oils come into contact with this mixture sulphurous or sulphuric acids form which disintegrate the copper of the windings, depositing copper sulphate upon the inside of the transformer tank or the windings.

The writer is familiar with one case where a large number of pole-type transformers failed from this cause. Several of the outer turns of the high-tension windings were disintegrated to a needle-point formation, and many of the turns were actually open-circuited. Some of the failures took place while the transformers were in the customers' stock room before they had ever been placed in circuit. It is a peculiar fact that although transformer oil will take up sulphur, its dielectric strength is not appreciably lowered.

How an Operator Secured a Better Starting Torque from Shunt Motor

In a Southern factory where a shunt motor was required to start under considerable load the operator improved the starting torque by the change in field connections shown in the accompanying illustration. The field connection to the motor starter was removed from the point marked *X* and connected at *Y*. This arrangement gives full field strength at the instant the main-line switch is closed and relieves arcing at the point *X* when starting the motor. The motor now starts easily when the starter arm is on the first point of the resistance.

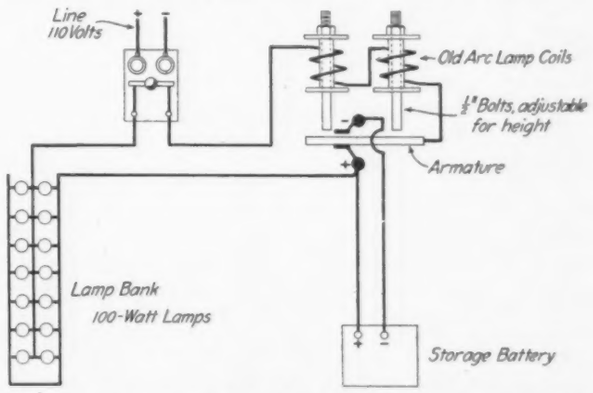


CONNECTIONS THAT IMPROVED STARTING TORQUE OF SHUNT MOTOR AND RELIEVED ARCING AT STARTER

An Arrangement to Throw a Battery Out of Circuit When Charging Current Is Interrupted

BY PAUL CAPRARO

A few years ago the writer was in charge of the electrical installation of a paper mill. The company operated a number of gasoline tugboats which used storage batteries for lighting and ignition. The current for charging these batteries was taken from a direct-current generator belted to a large Corliss en-

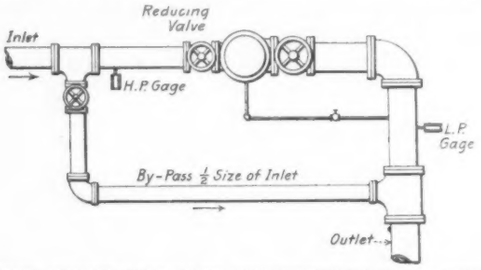


WIRING FOR DEVICE TO MAKE AND BREAK CHARGING CIRCUIT OF STORAGE BATTERY

gine. This engine was started and stopped as often as twenty times a day, so that when the generator stopped the batteries on charge would return current to the line unless the circuit was opened. To prevent this the scheme shown in the accompanying illustration was devised, which would automatically throw the battery in the charging circuit when the generator started and out again when it shut down. The outfit shown operated with a current of from 2 amp. to 14 amp.

Reducing Valve Connections and Control Arrangement

A convenient arrangement of connections and by-pass for reducing valves is illustrated in the accompanying diagram. The pressure-reducing valve is provided with a valve and gage on either side for readily determining the high and low pressures. Another valve is installed in a by-pass. The size of this by-pass should be not more than one-half the diameter of the inlet pipe to



A BY-PASS, VALVE AND GAGE CONNECTIONS FOR A REDUCING VALVE

prevent an excess pressure from developing on the low-pressure side. All fittings for turns should be installed in the by-pass, since this is seldom used, while the reducing valve should be installed in the straight run of the line. A small line for the automatic control of the reducing valve is taken from the latter and connected to the main on the low-pressure side. The method of dripping and the exact manner of piping may be changed to suit the conditions under which the device is installed.

A Serious Result from Trying to Make Wire-Pulling in Conduit Easy

By A. C. Hewitt

In an industrial plant the electrician had been experiencing trouble with intermittent grounds in the secondary circuit of an induction motor. The trouble was traced to the wires in iron conduit between motor and controller, and it was necessary to pull the wires out of the conduit. There were three No. 6 and three No. 1 stranded wires in the conduit, which was 50 ft. long with three 90-deg. bends. A chain hoist was used to pull the wires out.

The electrician was not familiar with good practice in conduit work nor with the Underwriters' rules, and since the wires pulled very hard a bright idea struck him which he immediately put into use. He poured a quart of black lubricating oil into the conduit at each end, when the wires came out easily. He hadn't thought of the effect of the oil on the rubber-covered wire! Two of the wires were found in bad condition, having been kinked and the insulation having been burned off. These were replaced with new ones and the six pulled back into place. Before a month had passed trouble again developed in the conduit, and the other four wires had to be removed—this time without the use of oil. All wires were pulled out and several balls of clean cotton waste were pulled through the conduit to clean out the oil. The wires have since been in service for about a year with no sign of a ground.

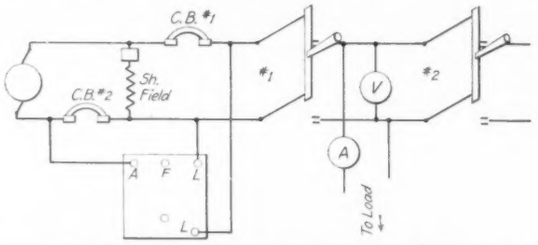
This instance is related to emphasize the need of proper instructions to workmen and thorough inspection during construction and repair work. When pulling wires into conduit, if a lubricant is necessary, paraffine should be used.

How a Laundry Secures Emergency Service from Central-Station Lines

By A. Hearvey

In a Washington (D. C.) steam laundry special arrangements are provided to use central-station service in case of failure of the steam equipment used. In this plant a 50-hp. slide-valve engine drives a main-line shaft, which is connected to machines on two floors. The engine exhaust is used for heating water.

To furnish energy for the lamps and a few variable-speed motors a 25-hp., 220-volt shunt generator is



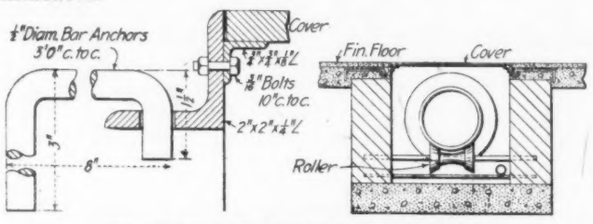
ARRANGEMENTS OF CIRCUITS TO USE CENTRAL-STATION SERVICE WHEN MECHANICAL DRIVE FAILS

mounted on a platform about 7 ft. above the floor of the lower story and is belted to the main-line shaft. In case of a failure of this generator, energy is secured from the lines of the central station by simply opening the generator switch No. 1 and closing the line switch No. 2 at the service entrance.

The plant is partly protected against a shut-down of the engine. A starting box has been installed at the main switchboard and connected, as shown in the diagram, so that the generator can be used as a motor and will carry a large part of the present load. To start the machine as a motor the circuit-breaker No. 1 is closed and No. 2 opened. The motor is then started in the usual way. When operated as a generator both circuit-breakers are closed and the starter is left open.

Trench Construction for Plant Piping and Cover-Plate Supports

A form of trench construction that may be used with concrete floors of power stations for piping runways is shown in the accompanying illustration. The trench may be constructed of masonry or concrete, or a combination as shown. A serviceable way of supporting the trench cover plates is also shown and consists of two angles bolted together, the larger angle being embedded in the concrete and held by a bar anchor, as indicated.



SUPPORTS FOR TRENCH COVER PLATES

Marketing Electricity

A Department on Selling Service and Widening the Use of Electrical Energy

Electricity for Sewer Digging and Excavation Pumping

How the Utah Power & Light Company of Salt Lake City, Through Its Portable Transformer Substations, Is Selling Motor Service to the Outside Contractor

BY BAYARD W. MENDENHALL, SALES SUPERINTENDENT

ALTHOUGH the work of the general outside contractor who builds roads, excavates for sewers, does grading, dredges river bottoms, etc., requires large amounts of power which might well be furnished from the central-station system, the supply of such service to movable equipment which covers any considerable distance in a day has in general proved impracticable on account of the necessity for so frequently changing service connections.

The Utah Power & Light Company of Salt Lake City, Utah, has, however, solved the difficulty by mounting portable substations on wagons for the use of such outside contractors. Each such substation (Fig. 1) is provided with 1000 ft. or more of secondary cable which can be paid out as needed, thus making available a range of 2000 ft. without a change in location of the substation. In some cases the contractor has enough electrical equipment to warrant employing his own electrician, and this man is competent to make primary connections to the power lines.

FIG. 1—TRANSFORMER SUBSTATION MOUNTED ON WAGON

Electric Pumps for Unwatering Ditches

One of the first jobs in which electric power was extensively used in the construction of sewers in Salt Lake City was a recent sewer extension which involved the digging of approximately 70 miles of trenches and the installation of sewer pipes varying from 6 in. to 6 ft. in diameter. The entire district was heavily watered—the permanent water table varying from 2 ft. to 10 ft. below the surface, and in some cases rising to several inches above the surface during certain seasons of the year. The removal of this water from the trenches quickly, safely and economically was one of the problems, since if this had not been done, the excavation would have been much more expensive. As the lines of the power company practically paralleled the excavations, electrically operated centrifugal pumps were called into service. The discharge of such an 8-in. pump operating in a manhole is shown in Fig. 2. Two other pumps, one a 4-in. and one a 3-in. unit, were necessary at this point to handle the large quantity of water encountered. The trench was 16 ft. deep and water was struck at a depth of 4 ft. Twenty pumping outfits, aggregating 117½ hp., were used on this job.

On Tenth South Street, where a 60-in. pipe was installed at a depth ranging from 12 ft. to 16 ft., an electrically operated excavator was used. An industrial

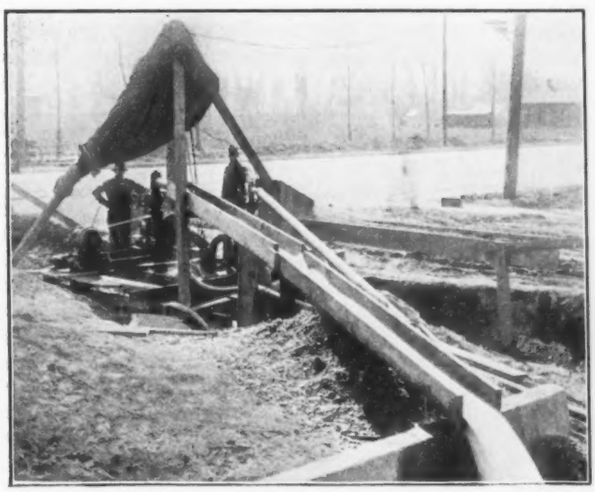


FIG. 2—UNWATERING SEWER TRENCH WITH AN 8-IN. CENTRIFUGAL PUMP

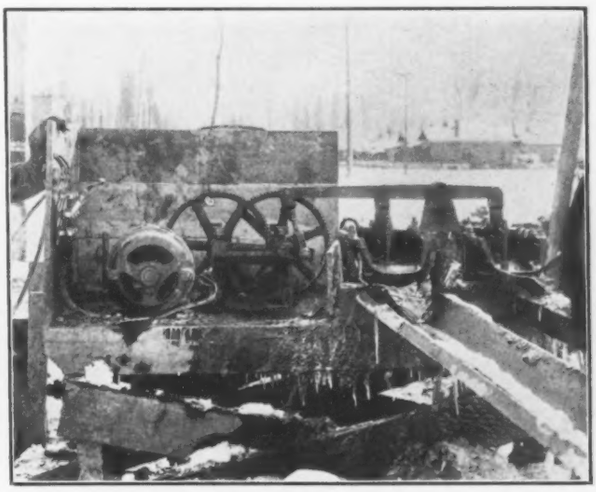


FIG. 3—ELECTRICALLY OPERATED DIAPHRAGM PUMP HANDLING 100 GAL. PER MINUTE

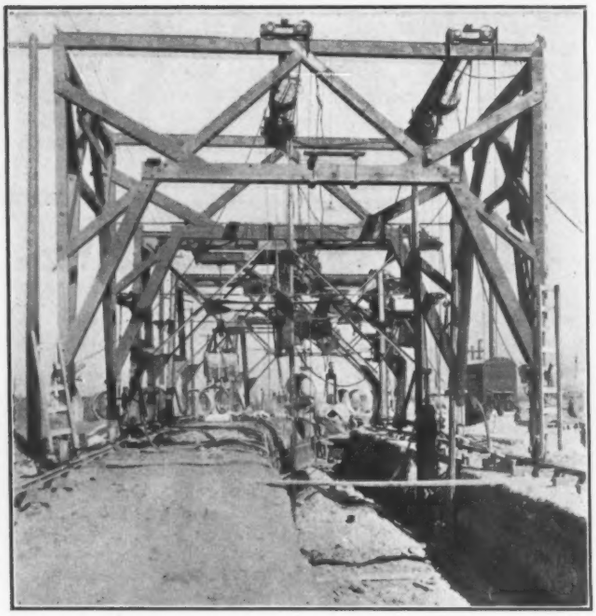


FIG. 4—PILE-DRIVER TRAVELER PLACING SHEET PILING

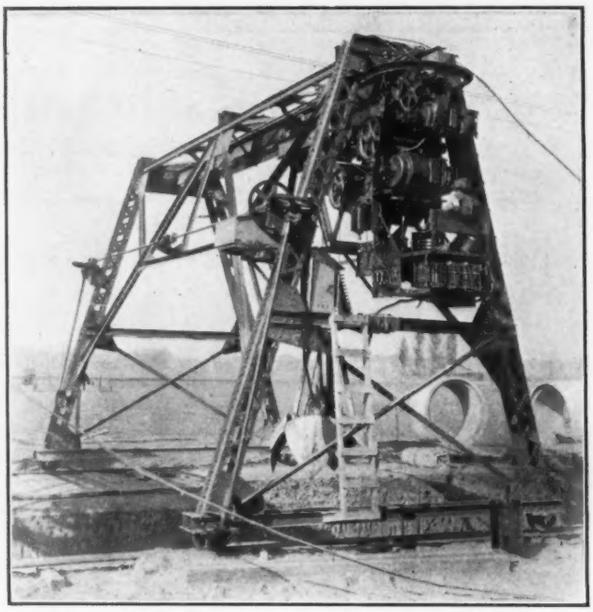


FIG. 5—ELECTRIC SHOVEL GANTRY FOR EXCAVATING

track was laid spanning the trench along which traveled this double-drum hoist, operated by a 22-hp. motor. A deadman supporting the cable was installed approximately 600 ft. behind the hoist, with a traveler operating on the industrial track between them at the point at which the excavating was being done. The hoist conveyed the buckets to the traveler, where they were lowered into the trench, filled, elevated and carried back and dumped beyond the point where the pipe had been completed, thus filling the trench. This outfit proved to be far more satisfactory than a similar steam equipment which was tried. The cost of operation was also considerably less.

Electric power was used extensively by W. M. Gibson in work on West Third, Fourth and Fifth North Streets, Salt Lake City. Here the quantities of water to be handled were less than on the Ulen job, and diaphragm pumps, both single and double mounting, were used. Since no electrically operated diaphragm pumps were available, the outfit shown in Fig. 3 was developed in Salt Lake City by the Ames agency in conjunction with the power company's engineers. The outfit (Fig. 3) handled readily 100 gal. a minute. It has the advantage that it does not require re-priming in case the water in the sump is exhausted, as do centrifugal pumps. Four 3-in. double-diaphragm and three 4-in. single-diaphragm pumps equipped as above, as well as one 3-in. centrifugal pump, were used on this job.

Electric Travelers for Digging a Trench 20 Ft. Deep

The latest and most extensive application of electricity to this kind of work is found in the contract recently awarded to Gibbon Brothers, Reed & Roche for the construction of an intercepting sewer extending from Ninth North Street and Eleventh West Street to Tenth South Street and Seventh West Street, a distance of approximately 0.75 mile. A sectional concrete pipe will be installed, the inside diameter ranging from 60 in. at its upper end to 78 in. at its outlet. This sewer pipe will be laid in a trench varying in width from 8 ft. at its upper end to 11 ft. at its outlet, with an average depth of 20 ft. The digging of this trench will require the removal of 150,000 cu. yd. of earth. The northern end of the ditch passes through a district containing considerable underground water. After studying carefully several different methods of handling the excavating of this trench and the laying of the pipe, the contractor decided on exclusive electrical equipment.

The Utah Power & Light Company had primary lines along the route of this sewer for most of its length. As the city will build a pumping plant at the sewer terminus to lift the sewage to the elevation of the gravity-sewer outlet, the company extended its transmission line along the sewer for the remainder of the distance. Two portable substations, each equipped with three 50-kw. transformers, are supplied, the one being used as a spare to be connected up ahead of the work while the others are in service. Secondary cables consisting of three 400,000-circ. mil cables are run out from the substation a distance of approximately 800 ft. either side. These cables are made up in lengths of 100 ft. and are connected together by junction boxes, at which points the various pieces of apparatus are connected to the secondary feeder as they move along the ditch.

Electric-Air Pile-Driver and Electric Shovel

The ditch is first excavated to a depth of approximately 5 ft. by means of horse-drawn scrapers. Beyond this depth it is not economical to use this method. Sheet piling is then driven down, using a pile-driving traveler, which is seen in the foreground of Fig. 4. The two forward Sprague hoists are of 0.5-ton capacity and handle the interlocking sheet-steel piling. The two rear hoists are of 1-ton capacity and handle the compressed-air hammers which are used in driving the piling. These hoists are rope-controlled from the ground. Compressed air for operating the hammers is furnished by an Ingersoll-Rand compressor of 400 cu. ft. free-air capacity belted to a 76-hp. General Electric motor. This compressor outfit is mounted on a truck and wheeled along an industrial railway beside the trench as needed. Two 0.75-yd. grab-bucket gantry cranes follow behind the sheet-piling crane and do the excavating. One of these cranes is equipped with an orange-peel bucket, the other with a clam-shell bucket. The former is shown in Fig. 5. These electric shovels, as well as the trench-laying crane described later, were built by the Sprague Electric Works of the General Electric Company. Each of the digging cranes is equipped with four hoisting motors. A 10-hp. motor operates the holding cables, a 22-hp. motor operates the drum which closes the bucket and is called the lacing

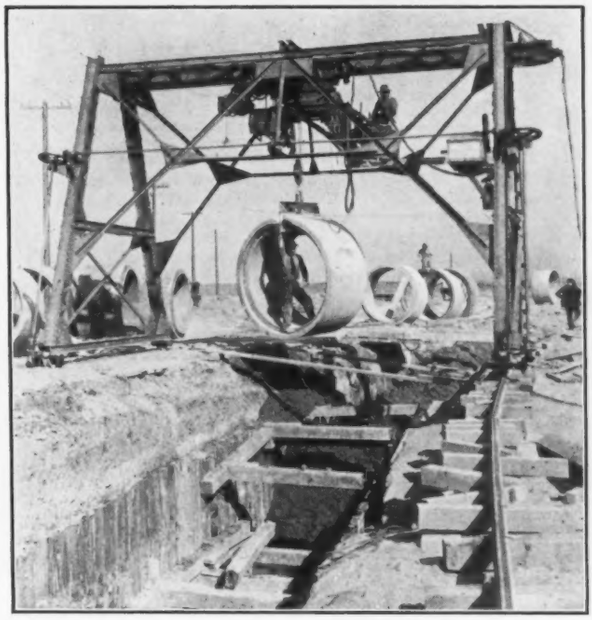


FIG. 6—PIPE-LAYING CRANE PLACING SEWER SECTIONS IN TRENCH

motor, a 6-hp. motor operates the cross-travel of the carriage, and a 10-hp. motor operates the longitudinal travel along the track. After the excavation is completed the pipe-laying crane picks up the lengths beside the trench and places them. This crane (Fig. 6) is equipped with a 30-hp. hoist motor, a 5-hp. trolley motor and a 10-hp. traction motor.

The electrical equipment also includes four vertical-shaft centrifugal pumps directly connected to 7.5-hp. motors which will be used in pumping water from the trench where needed. The aggregate connected load on this job is 256 hp.

While it is yet premature to get reliable information concerning the energy consumption per cubic yard handled, owing to the fact that the machinery is still stiff and the operators inexperienced, the equipment is proving to be all that the contractors expected of it. They are confident that they will be able to do the job more economically than they figured in their estimates on which their bid was based. The power company estimates a revenue of $5,000 from the job, and the preliminary indications are that this estimate will be not far from correct.

A Letter That Sells Washing Machines

The St. Joseph Railway, Light & Power Company of St. Joseph, Mo., is having marked success in the sale of washing machines. The method followed has been to send out a letter such as that reproduced herewith two or three days in advance of the salesmen.

ST. JOSEPH RAILWAY, LIGHT, HEAT & POWER COMPANY
ST. JOSEPH, MO.

DEAR MADAM—Our company is inaugurating in St. Joseph a series of demonstrations of the ——— washing and wringing machine, one of the greatest labor-saving devices ever placed in the home.

I will call on you personally in a few days and arrange to give you a complete demonstration in your own home and show you how the dreaded bugbear of the family washing—under the magic force of electricity—is transformed from a drudgery into one of the simplest and easiest parts of the housewife's daily duties in the home.

Few in St. Joseph have seen this wonderful machine work, but we are so enthusiastic about it that we are putting our guarantee back of that of the makers. We couldn't afford to recommend anything for the homes of St. Joseph that we hadn't thoroughly tried to know that it would back up all we claimed for it.

When I call I will explain the very easy terms and long-payment plan we have, which make it possible for every home to do its washing electrically.

Please read the inclosed circular. It contains valuable information to aid you in your home comfort and will show you how your wash days can be turned into "play days."

Yours very truly,
ST. JOSEPH RAILWAY, LIGHT, HEAT & POWER COMPANY.
———— ————, District Representative.

This letter creates an interest in the machine in advance of the personal call, and actual demonstrations in the home are welcomed in the majority of cases.

Another method used has been to send a letter similar to the one reproduced but mentioning that the district representative will telephone for an appointment to give a demonstration. This scheme also brought satisfactory results. The machines are also sent out on trial and the sales completed or the machines brought in each week end.

Brilliant Lighting Plays Rôle in Success of Omaha Motion-Picture Theater

Under several different earlier managements, the Strand Theater, Omaha, Neb., was a financial failure. The present management, upon taking hold of it, however, installed the very effective lighting display shown, and as a result the house is now apparently operating on a profitable basis. The motion pictures shown in the theater are of the best, but the present management's predecessors also ran the best film productions, and the music formerly offered was also of about the same quality as that now presented. Some measure of the recent success is therefore to be attributed to the attraction of the bright lights. The lighting scheme is unusually attractive. The opal globes on the coping and the marquis are alternately pink and white in color, giving a very pleasing effect; and the series of lamps outlining the principal lines of the building serve to emphasize the beauty of its architecture.

THE BRILLIANT ILLUMINATION SHOWN HAS BROUGHT THIS OMAHA THEATER FROM FINANCIAL FAILURE TO BUSINESS SUCCESS

Calculating Wire Sizes for Alternating-Current Circuits

BY LOUIS W. MOXEY, JR., VICE-PRESIDENT KELLER-PIKE COMPANY, PHILADELPHIA

In the present article, the fifth of the series prepared by Mr. Moxey on the subject of the electrical-contracting business, the author outlines methods of calculating the voltage drops in alternating-current circuits due to effects of inductance and capacity. General data for interior-conduit work are also given. In the preceding installment, printed in the issue of last week, there was described the method of calculating resistance drop in direct-current circuits. Earlier articles of the present series dealt with general business methods for the electrical contractor (Oct. 16), labor costs in interior construction (Oct. 23), and accounting and cost-keeping methods (Nov. 20). The following installments, which conclude the series, will take up illumination calculations and methods of overhead and underground construction.

IN figuring the voltage drop in alternating-current circuits there are a number of voltage losses to be taken into consideration in addition to the resistance drop—namely, skin effect, inductance and capacity. The skin effect is very small unless the size of the wires is excessive. The other losses may be considerable. The writer has worked out multiplying factors which, when applied to the cross-section of wires as figured for resistance drop, give fairly accurate values for the total voltage drop in alternating-current circuits, provided that all the wires of the circuit are placed in the same conduit.

Before considering the subject of voltage drop, however, it is best to discuss the subject of power-factor. The power-factor of a generator, motor or complete wiring system is the ratio of the actual power required to the apparent power required, or it is the ratio of the power required as measured on a wattmeter to the product of the voltage and current as measured on a voltmeter and an ammeter. For example, a 20-hp. motor theoretically should consume at full load 20×746, or 14,920 watts. When the voltage and current at full load are actually measured, it may be found that their product is 18,660 watts, in which case the power-factor would be $14{,}920 \div 18{,}660$, or 80 per cent. In other words, to obtain the volt-ampere intake of an alternating-current motor, divide the rating of the motor in watts by the power-factor in per cent and multiply by 100. Divide this result by the voltage, and the result is the current required in amperes.

The power-factor of a circuit varies with the types of the loads connected, the values given in Table XXIX being what the United States Treasury Department gives as fair averages.

The writer has found that a good method for finding the sizes of wire required in an alternating-current system for a given voltage drop where all wires of the circuit are run in the same conduit is first to base the calculation on a two-wire direct-current system at the same voltage, including, of course, the power-factor in calculating the current. For example, consider the calculations for a two-phase, 220-volt, four-wire main feeding a 50-hp. motor. The length of the run is 200 ft., the voltage drop is to be 2.2 volts, or 1 per cent, and the power-factor is 80 per cent.

Rating of motor in watts $= 50 \times 746 = 37{,}300$ watts.

Current without power-factor allowance $= 37{,}300 \div 220 = 169.5$ amp.

Current with power-factor allowance $= (169.5 \div 80) \times 100 = 211.9$ amp.

The resistance that would be required in a two-wire direct-current circuit to give a drop of 2.2 volts with a current of 211.9 amp. would be $2.2 \div 211.9$, or 0.01 ohm.

A wire having a resistance of 0.01 ohm for 200 ft. of circuit or 400 ft. of wire would have a cross-sectional area of about 400,000 circ. mils.

The next step would be to find the size of wire based on a two-phase, four-wire system at the same voltage and having the same percentage of voltage drop. Table XXX shows the relative sizes of wires for all systems when carrying the same load at the same percentage of voltage drop.

In the example given it was found that for a two-wire, direct-current, 220-volt, 50-hp. motor a conductor having a cross-section of 400,000 circ. mils would be required. For a two-phase, 220-volt, four-wire system the size of wires per leg would be one-half of this size, or 200,000 circ. mils. This cross-section of 200,000 circ. mils corresponds approximately to a No. 0000 B. & S. gage conductor. However, the cross-section must be

TABLE XXIX—AVERAGE POWER-FACTORS FOR LIGHT AND POWER IN PER CENT

Incandescent lamps	95
Arc lamps	70
Incandescent lamps and induction motors on same circuit	85
Induction motors, full load	80
Induction motors, constant-speed type, starting	60
Induction motors, elevator-type, starting	40

TABLE XXX—RELATIVE SIZES OF WIRES FOR SAME LOAD AND PERCENTAGE VOLTAGE DROP

Volts	No. of Wires	No. of Phases	Kind of Energy	Cross-Section of Wires	Total Cross-Section
110	2	..	D.C.	A; A	2A
110	2	1	A.C.	A; A	2A
220	2	..	D.C.	A/4; A/4	0.5A
220	2	1	A.C.	A/4; A/4	0.5A
110-220	3	..	D.C.	A/4; A/4; A/4	0.75A
110	4	2	A.C.	A/2; A/2; A/2; A/2	2A
110	3	2	A.C.	A/2; 1.4A/2; A/2	1.7A
220	4	2	A.C.	A/8; A/8; A/8; A/8	0.5A
220	3	2	A.C.	A/8; 1.4A/8; A/8	0.425A
110	3	3	A.C.	A/2; A/2; A/2	1.5A
220	3	3	A.C.	A/8; A/8; A/8	0.375A

Plus increase for inductive reactance drop

TABLE XXXI—MULTIPLYING FACTORS FOR SIXTY-CYCLE, TWO-PHASE AND THREE-PHASE ALTERNATING-CURRENT CIRCUITS*

Size of Wire as Calculated			Cross-Section Required in Circ. Mils	Nearest Commercial Size to That Required
Gage No., B. & S.	Circ. Mils	Multiplier		
14	4,107	1.00	4,107	14
12	6,530	1.00	6,530	12
10	8,234	1.00	8,234	10
8	16,509	1.00	16,509	8
6	26,250	1.00	26,250	6
5	33,102	1.01	33,430	5
4	41,742	1.02	42,577	4
3	52,634	1.03	54,203	3
2	66,373	1.06	70,355	1
1	83,694	1.09	91,227	0
0	105,534	1.12	118,198	00
00	133,079	1.21	161,026	000
000	167,805	1.32	221,503	225,000
0000	211,600	1.47	311,052	300,000
	250,000	1.62	405,000	400,000
	300,000	1.82	546,000	550,000
	350,000	2.06	721,000	750,000
	400,000	2.28	912,000	950,000
	450,000	2.53	1,138,500	1,200,000
	500,000	2.86	1,430,000	1,500,000

*These figures are based on rubber-covered wires run in conduit, all wires of one circuit being run in the same conduit. They should, hence, only be used where these conditions exist.

increased to take care of the inductive reactance drop.

For estimating purposes the writer has prepared Table XXXI of multiplying factors for use in computing sixty-cycle alternating-current circuits. Multiplying the cross-sectional area of a conductor as found above by the factor given in the table, the approximately correct size of rubber-covered wire will be obtained, provided that all wires of one circuit are run in the same conduit.

The size of wire which would have been required for a direct-current system was found to be of 200,000-circ. mil cross-section. The multiplier in this case as found in Table XXXI is 1.47. Hence $200{,}000 \times 1.47 = 294{,}000$ circ. mil, the nearest commercial size being a 300,000-circ. mil wire.

Before deciding that a 300,000-circ. mil wire is the proper size to use, it should be checked for carrying capacity. Table XXXII gives the current required by alternating-current motors per horsepower per phase for different voltages, the effect of power-factor being taken into consideration. The values given have been found to be fair averages for all types of alternating-current motors.

It was found that a 300,000-circ. mil wire was the proper size for taking care of the voltage drop. The starting currents are:

$$(50 \times 2.5) \times 1.4 = 175 \text{ at no load}$$
$$(50 \times 2.5) \times 1.8 = 225 \text{ at full load}$$

In both cases the current is below the allowable carrying capacity of a 300,000-circ. mil cable, namely, 275 amp. Hence it is safe to use cables of this cross-section.

General Data for Interior Conduit Work

Such data as have been found necessary for the estimating and laying out of both large and small interior-conduit installations are given on these pages. Data such as can be obtained from tables in the National Electrical Code and from manufacturers' literature are, in general, omitted for lack of space. Rule 58 of the National Electrical Code gives tables of conduit sizes, weights, etc., which will often prove of value in laying out installations. Contractors will also find it convenient to prepare a table of outside diameters of conduit couplings. Such tables will permit them to determine the minimum clearance that must be allowed for conduit runs.

Table XXXIII gives the outside diameters of bushings and lock nuts for use with conduit. These permit the minimum distances to be allowed between the centers of conduits entering junction boxes to be determined.

The writer has found it convenient to employ tables

TABLE XXXII—CURRENT CONSUMPTION OF ALTERNATING-CURRENT MOTORS*

Motor		Amperes per Hp. per Phase
Phases	Volts	
1	110	10
1	220	5
2	110	5
2	220	2.5
3	110	4
3	220	2

*When starting without load, the currents given in the table should be multiplied by 1.4, and when starting at full load the values should be multiplied by 1.8.

TABLE XXXIII—OUTSIDE DIAMETERS OF BUSHINGS AND LOCK-NUTS

Size, In.	Outside Diameter of Bushings, In.	Outside Diameter of Locknuts, In.	Thickness of Bushings, In.	Thickness of Locknuts, In.
1/2	1	1 1/8	7/16	1/8
3/4	1 5/16	1 7/16	3/8	1/8
1	1 1/2	1 3/4	1/2	5/32
1 1/4	1 13/16	2 5/16	9/16	3/16
1 1/2	2 1/8	2 9/16	5/8	3/16
2	2 5/8	3 1/8	5/8	3/16
2 1/2	3 1/8	3 3/4	3/4	5/16
3	4	4 7/8	7/8	5/16
3 1/2	4 7/16	5 1/8	1	5/16
4	5	4 7/8	1	4/10

TABLE XXXIV—APPROXIMATE SIZES OF PANELBOARDS, DIMENSIONS IN INCHES*

Number of Circuits	Two-Wire Mains, Two-Wire Branches		Three-Wire Mains, Two-Wire Branches, 110 Volts
	110 Volts	220 Volts	
2	7x22	7x22	7x22
4	11x22	11x22	11x22
6	15x22	15x22	15x22
8	17x22	20x22	17x22
10	20x22	23x22	20x22
12	23x22	27x23	23x22
14	27x23	32x23	27x23
16	29x23	35x23	29x23
18	32x23	39x23	32x23
20	35x23	44x24	35x23
22	39x23	48x24	39x23
24	41x24	52x24	41x24
26	44x24	56x24	44x24
28	48x24	60x24	48x24
30	52x24	64x24	52x24

*For panels where fuses are 30 amp. and under and where no fuses or switches are provided on the main buses.

TABLE XXXV—APPROXIMATE SIZES OF PANELBOARDS*

Number of Circuits	Two-Wire Mains, Two-Wire Branches, Dimensions, Inches		Three-Wire Mains, Two-Wire Branches, Dimensions, Inches, 110 Volts
	110 Volts	220 Volts	
2	5.75x12	7x12	5.75x13.5
4	8 x12	10x12	8 x13.5
6	10.25x12	14x12	10.25x13.5
8	12.5 x12	17x12	12.5 x13.5
10	14.75x12	21x12	14.75x13.5
12	17 x12	24x12	17 x13.5
14	19.25x12	27x12	19.25x13.5
16	21.5 x12	30x12	21.5 x13.5
18	23.75x12	34x12	23.75x13.5
20	26 x12	37x12	26 x13.5
22	28.25x12	40x12	28.25x13.5
24	30.5 x12	43x12	30.5 x13.5
26	32.75x12	47x12	32.75x13.5
28	35 x12	50x12	35 x13.5
30	37.25x12	53x12	37.25x13.5

*For panels where N.E.C. inclosed fuses of 30 amp. and under are employed. No switches are assumed to be used on branch buses, and the main buses are assumed to be without switches or fuses.

TABLE XXXVI—AVERAGE OVER-ALL DIMENSIONS OF N. E. C. FUSED AND FUSELESS SWITCHES, FRONT-CONNECTED*

	Size	Double-Pole, Inches	Three-Pole, Inches	Four-Pole, Inches	Five-Pole, Inches
		H. W. D.	H. W. D.	H. W. D.	H. W. D.
Fuseless Switches	30	11 7 2 9/16	11 10 2 9/16	11 12 2 9/16	11 15 2 9/16
	60	13 8 2 7/8	13 11 2 7/8	13 14 2 7/8	13 17 2 7/8
	100	15 9 3 1/4	15 12 3 1/4	15 15 3 1/4	15 19 3 1/4
	200	19 10 4 5/16	19 13 4 5/16	19 17 4 5/16	19 21 4 5/16
		H. W. D.	H. W. D.	H. W. D.	H. W. D.
Fused Switches	30	11 7 2 13/16	11 10 2 13/16	11 12 2 13/16	11 15 2 13/16
	60	13 8 3 3/8	13 11 3 3/8	13 14 3 3/8	13 17 3 3/8
	100	17 9 4 1/2	17 12 4 1/2	17 15 4 1/2	17 19 4 1/2
	200	21 10 5	21 13 5	21 17 5	21 [illegible]

*Data furnished by the Walker Electric Company, Philadelphia.

giving the desirable sizes of conduit to use with various sizes and numbers of mains and circuits. However, it is no longer necessary for a contractor to prepare such tables, as the 1915 edition of the National Electrical Code will specify, under Rule 28, the size of conduits to be employed for the installation of wires and cables.

Tables XXXIV and XXXV give approximate sizes of panel in cases where N. E. C. inclosed fuses are employed, while Table XXXVI gives approximate sizes of switches. In addition to the tables here given a table of the carrying capacity of wires is needed. However, such a table is generally in the possession of every contractor, one being incorporated in the National Electrical Code.

In calculating the sizes of boxes allowance must be made for the space occupied by bushings and for space in which to make the necessary wiring connections, together with the distance required by the National Electrical Code between live parts and sides and front of box.

To Revive an Old-World Custom—Christmas Candles in the Window

The Commonwealth Edison Company, through its Electric Shop, is endeavoring this year to revive the ancient and beautiful Christmas custom of burning candles in the front windows of dwellings as a message of Christmas greetings and good will to the passers-by. For this purpose special electric Christmas candles have been designed for exclusive sale in Chicago, the bases being silver-plated with frosted lamps and oval silk shades. These candlesticks will be sold preferably in pairs, with a Christmas greeting from the company, and an urgent request that these candles be exposed throughout Christmas week, without their shades, in the living-room windows between the window and the curtains. The effect of a residence street on a snowy winter night with many of these beautiful candle lamps shining from the windows will be delightful and wonderfully suggestive of the Yuletide spirit. After the holidays they may be used very effectively as boudoir lamps, either with or without the silk shades.

To aid in the promotion of this quaint Christmas custom and to secure the largest possible distribution of these candles, the company is offering the lamps at practically their actual cost, and it is planned to make this an annual feature of the Christmas campaign in Chicago until every household in which the Christmas spirit abides proclaims its Christmas greeting in this manner. At the same time an energetic campaign will be made for the sale of regular Christmas-tree lighting outfits for the decoration of all Christmas trees.

ELECTRIC CHRISTMAS CANDLES IN THE WINDOW

THE CANDLESTICKS MAY BE USED AS BOUDOIR LAMPS AFTER THE CHRISTMAS SEASON

Church Societies Sell 500 Electric Irons

Five hundred irons in ten days is the record of an unusual selling scheme recently employed in Lincoln, Neb. Five church societies were entered in a contest to sell electric flatirons, the society selling the most to receive a fifty-dollar gas range, and the society selling the next highest number to receive a twenty-dollar range. To each society was given the use of the company's store for two days, and the company advertised in the newspapers that each society in turn would have the use of its display room for the period. The same announcement was also made from the pulpits and thus received a wide and favorable publicity. In addition to the prizes, each society received 25 cents commission on each iron sold during its two days.

The sales were all made cash, and the company's demonstrator and clerk were kept busy demonstrating and wrapping the irons. The women entered into the contest with great zeal. They used the telephone to advantage, calling up members and friends and urging them to "buy now" while the society had charge of the store. The irons were sold for $2.20, but the company was still enabled to show a slight profit. The contest was suggested by J. E. Shuff, contract agent of the Lincoln Gas & Electric Light Company.

Heaters Better Than Fans for Driving Moisture and Frost from Jewelers' Windows

C. J. Duncan, a jewelry merchant of Massillon, Ohio, uses two 250-watt luminous heaters to drive the view-obstructing moisture from his display windows. When asked why he used heaters instead of fans, Mr. Duncan replied that the breeze created by fans frequently disarranges displayed goods and blows dirt and dust particles over the jewelry. In addition, Mr. Duncan pointed out, the heaters maintain uniform temperature in the window, a condition which is desirable.

Technical Advance in Theory and Practice

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

COBALT IN ELECTRICAL ENGINEERING

Its Use in Electroplating and as an Alloying Element with Iron for Electrical Purposes

Cobalt, according to the textbooks, is a metal which has few uses. The truth of this statement became annoyingly apparent when, some ten years ago, the Canadian silver-cobalt deposits began to attract wide attention and exploitation. Since then much work has been done on possible applications of cobalt. One application which is increasing steadily in favor is electroplating with cobalt. A cobalt coating is similar, and perhaps even superior in some ways, to a nickel plating. But cobalt costs considerably more than nickel, and it is not likely that this relation will soon be changed. Yet the extensive researches which have been carried out by Dr. Herbert T. Kalmus for the Canadian Department of Mines on cobalt plating indicate that the higher cost of the metal is not prohibitive, since savings may be had

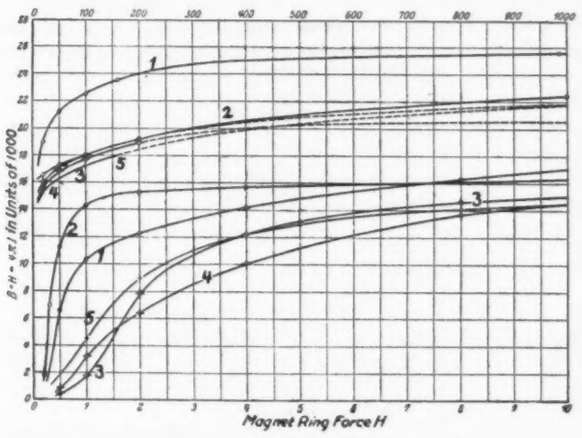


FIG. 1—MAGNETIZATION CURVE FOR IRON-COBALT ALLOY COMPARED WITH THOSE FOR OTHER METALS

in other directions, such as in the time of plating and in the weight of deposit required to get a satisfactory coating. Readers interested in the future possibilities of cobalt plating will find a great deal of information in the complete and quite voluminous report on the work done in this field by Herbert T. Kalmus, C. H. Harper and W. L. Savetl, issued by the Canadian Department of Mines as *Bulletin No.* 334.

A second new application of cobalt is its use as an alloying element with iron. Nor is this really surprising if we remember the similarity of cobalt and nickel and think of the immense usefulness of nickel steels. In this respect an article by Tr. D. Yensen of the University of Illinois in the *Elektrotechnische Zeitschrift* of Nov. 11, 1915, is interesting, as it relates to the magnetic properties of the iron-cobalt alloy Fe_2Co. Electrolytically refined iron was the starting material, and this as well as the iron-cobalt alloy (containing 33.33 per cent Co) was melted in vacuo. Comparative tests were made with standard transformer steel, 4 per cent silicon steel and Swedish charcoal iron. The results are given in the article in the form of numerous tables and diagrams.

One of the most interesting results which had already been found by P. Weiss in Zurich is that the magnetic saturation is higher by 10 per cent for ferro-cobalt than for pure iron. Of greater practical importance, however, are the determinations of the complete magnetization curves by the present author. They are shown in Fig. 1. Curve 1 relates to the iron-cobalt alloy melted in vacuo, curve 2 to pure iron melted in vacuo, curve 3 to commercial transformer steel, curve 4 to commercial 4 per cent silicon steel, curve 5 to Swedish charcoal iron. While near saturation the magnetizing curve of the iron-cobalt alloy is 13 per cent above that for pure iron, as already mentioned; it is even 25 per cent above that for pure iron at medium field intensities, H = 50 to 200. The iron-cobalt curve cuts the pure-iron curve at H = 7.5 and remains below the latter for lower magnetizing forces. The highest permeability of the alloy is 13,500, which is much higher than that of the best transformer steels. The hysteresis losses are as low as or lower than those of commercial steels. The hysteresis loop and the permeability curve for the iron-cobalt alloy, melted in vacuo at 900 deg. C., are shown in Fig. 2. The author thinks this alloy will

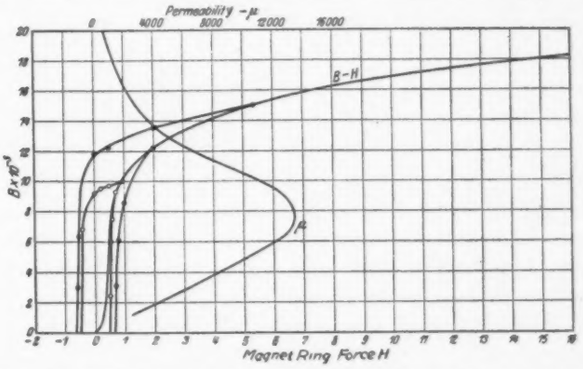


FIG. 2—HYSTERESIS LOOP AND PERMEABILITY CURVE FOR IRON-COBALT ALLOY

be useful wherever the magnetic flux density is high, though the brittleness of the alloy and the present price of cobalt are still practical obstacles to a more general use.

Generators, Motors and Transformers

Thermal Characteristics and Intermittent Rating.—The second part of an elementary but very clearly written article on the rating of intermittent machines, dealing first with the load-factor method. In the present installment the author discusses intermittent running on a cycle of long duration. The method of rating the intermittent motor by the root-mean-square method is next described, and a bibliography on the subject is added.—London *Electrician*, Oct. 22, 1915.

Lamps and Lighting

Ductile Tungsten.—A review of the different German patents for processes of making ductile tungsten. The behavior of tungsten lamps when operated with alternating-current is finally discussed. Alternating current has a destructive effect on tungsten as on tantalum filaments. This disadvantage may be overcome by the use

of 0.02 per cent of phosphorus in tungsten. This small percentage does not decrease the ductility of the filament. According to another method, the dilute solution of a calcium salt is added to a mixture of 92 per cent metallic tungsten and 8 per cent nickel oxide. After completely drying, the mixture is reduced with hydrogen and rods are formed by sintering. The nickel is removed by heat so that there is finally obtained a wire of tungsten containing calcium oxide, which is not affected by alternating current.—*Elek. Zeit.*, Sept. 16, 1915.

Vacuum Tungsten Lamps.—J. F. SKOGLAND.—An account of an investigation in which was developed a direct-reading device for use in computing characteristics of vacuum tungsten lamps (with computing chart). The characteristic equation of vacuum tungsten lamps is employed in constructing a computing device consisting of volt, watts-per-candle and per-cent-candle-power scales, from which may be read, by a single setting of the movable volt scale to observed values within the range of from 0.7 watt to 2.05 watts per candle, values of any of the variables at other points. The volt scale has a range of from 94 volts to 166 volts. The limits in watts per candle and voltage were chosen to include values most generally used in laboratory and factory practice. The chief advantage which this device possesses over other methods of characteristic evaluation, including the use of tables, is a great saving of time, this resulting because of the directness of solutions without reference to normal watts per candle, voltage ratios, exponents, etc.—*Bulletin Bureau of Standards*, Vol. 12, No. 2, Nov. 8, 1915.

Hefner Standard Lamp.—E. OTT.—A contribution from the laboratory of the Schlieren works of the Zurich gas plant, communicated by the International Photometric Commission. There has been some discrepancy in the formulas proposed for the candle-power of the Hefner lamp as affected by atmospheric conditions. In order to determine this effect definitely, the author made measurements in a closed receiver, the pressure being varied between wide limits. Three sets of determinations were made. The author concluded that in order that conditions should be uniform and well defined and the light of the Hefner lamp be subject to proper corrections, photometer tests with it must always be made in well-ventilated and sufficiently large rooms. The intensity of light y then depends only on the natural humidity of the outer air and the atmospheric pressure and may without objection be calculated from the abbreviated Liebenthal formula

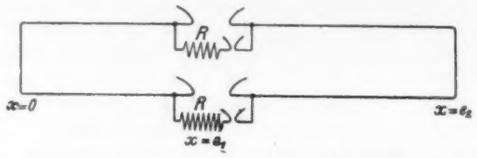
$$y = 1.049 - 0.0055x + 0.0011(b - 760)$$

where x is the volume, expressed in liters, which the aqueous vapor associated with 1 cu. m. of dry air free from carbon dioxide would have at the same temperature and the same pressure, and b is the atmospheric pressure within the range from 816 mm. to 717 mm. of mercury.—London *Electrician*, Nov. 19, 1915.

Generation, Transmission and Distribution

Saarlouis-Merzig Transmission and Distribution Plant.—WILHELM GOSEBRUCH.—The capital invested in this system was procured by the counties of Saarlouis and Merzig in western Germany. The system was erected and is being managed on a rental contract by a Berlin steel company. The capital invested is $2,250,000, of which one-third was spent on the interurban electric-railway system and the balance on the transmission and distribution system. The Saarlouis district is highly industrial, the Merzig district chiefly agricultural. The power plant in Saarlouis contains two fifty-cycle, 6600-volt, 1250-kw., three-phase turbo-generators and one of 5400 kw. The 750-volt traction current is obtained from three synchronous converters of 400 kw., 250 kw. and 150 kw. respectively. The three-phase currents are transmitted partly at 6600 volts and partly at 25,000 volts. The network is interconnected with that of the city of Trier. There are five substations. The district supplied with energy comprises 862 sq. km. (340 sq. miles) and has 123,000 inhabitants. The author gives some details of the transmission-line construction. The design of the poles follows closely that of the Ontario transmission system. Some notes are added on the transformer stations and the protective devices, as well as on the telephone system.—*Elek. Zeit.*, Oct. 21 and 28, 1915.

Breaking Circuits Carrying Large Alternating Currents.—J. BIERMANNS.—After a historical review, the author discusses critically the manner in which alternating-current circuit-breakers operate. The phenomena which occur when an oil circuit-breaker or a horn



ARRANGEMENT OF APPARATUS TO ENHANCE SAFE OPERATION OF ALTERNATING-CURRENT CIRCUIT-BREAKERS

circuit-breaker operates are discussed in detail. When short-circuited lines or lines carrying an inductive load are disconnected dangerous rises of voltage occur. The author discusses these and describes an arrangement which reduces the danger materially and which protects equally well the lines on both sides of the circuit-breaker. It is shown above, the ohmic resistance R being in series with the air-gap of a horn lightning arrester.—*Archiv für Elektrotechnik*, Vol. 3, page 5, very briefly abstracted in *Elek. Zeit.*, Oct. 21, 1915.

Installations, Systems and Appliances

Association of Austrian and Hungarian Central Stations.—An account of the proceedings of the twelfth annual convention of the Association of Austrian and Hungarian Central Stations, which was held in Vienna. Karel (Vienna) was elected president in place of the late H. Sauer. One of the principal subjects of discussion was the activity of the government in "mobilizing copper." Professor Hockenegg gave an outline of different means by which electric-lighting stations and traction systems can render copper available. Karel described how the Vienna Electricity Works had rendered available 447,000 kg. copper, 175,000 kg. lead, some 6000 kg. copper alloys and 655 kg. aluminum.—*Elek. Zeit.*, Nov. 4, 1915.

Shanghai Electricity Works.—The conclusion of an illustrated article on recent extensions of the electric supply stations of Shanghai. Though the Riverside station has hardly been completed, additional plant of 20,000 kw. is to be installed, which will bring the rating up to 34,000 kw. An extension of the Fearon Road station will bring it up to 3200 kw. (in addition to the traction plant), making the total rating of the Shanghai municipal plant 37,200 kw. Last year 32,885,000 kw.-hr. was sold. The figure for this year is expected to be 56,000,000 kw.-hr., made up as follows: Private lighting, 16,980,000 kw.-hr.; motor service, 33,612,000 kw.-hr.; heating, 554,000 kw.-hr.; public lighting, 1,000,000 kw.-hr.; traction, 4,000,000 kw.-hr.—London *Elec. Review*, Nov. 19, 1915.

A Return to Flat Rates for Lighting Service.—FRIEDRICH SCHMIDT.—On account of the present scarcity of kerosene oil in Germany, owners of many small houses have requested the central stations to connect them to

the electricity supply, but the making of connections has been delayed by the scarcity of copper and the insufficient supply of meters. The author thinks most of the service rates at present in use for charging for domestic supply are too complicated; there is too much finesse and red tape, and consequently general administration and overhead expenses are high. He recommends greatest simplicity of the service rate, but restricts his remarks to ordinary small consumers. He recommends a flat rate generally for lighting without any power-limiting devices or any complications whatsoever. He makes the 25-watt lamp the unit and assumes for the first 50 watts of connections 1200 hours of burning, for the next 25 watts 1000 hours, and so on, which gives a flat rate of $2.25 for 25 watts, $4.25 for 50 watts, $6.25 for 75 watts, $8 for 100 watts, $9.50 for 125 watts, $10.75 for 150 watts, $11.75 for 175 watts, $12.75 for 200 watts, and then $1 more for any 25 watts more. For electric flatirons a special contact is provided for which a yearly flat rate of $1.50 is charged. For instance, if an installation comprises four 25-watt lamps and a flatiron connection, the yearly rate is $9.50. No money is collected in June and July; the bill for each of the other ten months is therefore 95 cents. Energy for motor-service purposes is metered, but, according to the author's suggestion, the meter is provided with a counting device which does not give kilowatt-hours but directly dollars and cents. This saves a great deal of figuring, explaining, etc. In this way the collection of bills becomes extremely simple.—*Elek. Zeit.*, Oct. 28, 1915.

Wires, Wiring and Conduits

Radiation and Convection from a Heated Wire.—T. BARRATT.—An abstract of a (British) Physical Society paper. The author endeavored to determine the numerical relation between the radiation and convection losses from a heated metallic wire or rod placed in a gas at constant temperature. The method consisted in (1) measuring the amount of heat required to maintain the temperature of the wire a given amount (10 deg. C.) above that of the surrounding gas, the surface of the wire being (*a*) coated with a dead-black varnish, (*b*) uncoated; (2) comparing the radiations from two surfaces exactly similar to *a* and *b* by means of a thermopile. It is shown that if the total heat lost from unit surface of the wire is x times greater from a "black" wire than from a bare wire, while the radiation from the black surface is y times more than that from the unblacked surface, then

$$\frac{r_2}{c} = \frac{x-y}{x-1} \quad \text{and} \quad \frac{r_1}{c} = \frac{y(x-y)}{x-1}$$

where r_2 and r_1 are the radiations from "black" and "bare" surfaces respectively and c is the convection. The experiments indicate that of 100 parts of "total heat" lost from a wire at air temperatures 2.5 consist of radiation for a bare wire and 12.6 for a "black" wire. At 100 deg. C. these percentages become 4.4 and 20.7 respectively.—London *Electrician*, Nov. 19, 1915.

"Mobilization" of Copper in Germany.—The special law is printed in full according to which a complete "census" of all electrical machinery (motors, generators, converters, transformers, switches, fuses, meters, etc.) in existence in Germany is being made, in order to arcertain which of them are in use and needed and which are not, so that copper may be made available for war purposes.—*Elek. Zeit.*, Oct. 28, 1915.

Electrophysics and Magnetism

Delta Radiation from Zinc When Bombarded by Alpha Rays.—J. C. MCLENNAN AND C. G. FOUND.—An account of an experimental investigation in which it is shown that when a plate of zinc with a freshly scraped surface is placed in a highly exhausted chamber and bombarded by alpha rays there is an emission of slow-moving electrons or delta rays from it at the rate of three electrons for each alpha particle impact. It is also shown that the emission of electrons from such a plate of zinc under bombardment by alpha rays diminishes with the lapse of time from the moment when it is placed in the high vacuum. Initially there is no emission of electrons under bombardment by alpha rays from a surface of zinc deposited from zinc vapor in a high vacuum, but as time elapses an electronic emission is developed under the gradual absorption of air by the surface of the zinc deposit.—*Philos. Magazine*, October, 1915.

Electrochemistry and Batteries

Electric Precipitation of Smoke, Fumes and Dust.—LINN BRADLEY.—An address giving an outline of the surprising variety of smoke problems, fume problems and dust problems to the solution of which the Cottrell process of electric precipitation has been applied. A high-voltage (75,000 to 100,000 volts) intermittent direct-current is used, which is obtained by transforming low-voltage alternating current into high-voltage alternating current and then converting or rectifying the latter. The amount of power required in commercial installations is relatively low, generally much lower than in other gas-cleaning systems. Unique advantages of electrical precipitation are its ability to collect even the most minute particles and the possibility of "fractional precipitation." In the latter method the gases are treated while at a high temperature to remove those materials which are then either solid or liquid, and then after cooling the gases are subjected to another treatment in a separate precipitator. Arsenic trioxide of high purity has thus been separated from copper, iron, zinc and other materials. It would be possible to obtain water-free tar in gas plants by this means, and it also might be possible to collect tars of different compositions.—*Met. and Chem. Eng'ing*, Dec. 1, 1915.

Telegraphy, Telephony and Signals

Telephone Relay.—A note on a recent British patent (No. 8903, 1915) of V. Zedeschi and A. G. Rossi for "a reversible relay for amplifying the energy of small periodic currents through the medium of mechanical work. The rotation of a solid continuous metal disk of high conductivity determines the inductive effect between two stationary identical symmetrical and insulated windings at right angles to each other and to the plane in which the disk rotates so that they shall not present any mutual induction when the disk is stationary."—London *Elec. Eng'ing*, Nov. 18, 1915.

Telephone Relay.—A note on a recent British patent (No. 1694, 1915) of the Western Electric Company for a "thermo-ionic amplifier for telephone currents in which a maximum efficiency is obtained by placing the input electrode as close as possible to the source of ionization or cathode while sufficiently far to insulate it."—London *Elec. Eng'ing*, Nov. 18, 1915.

Miscellaneous

Electric Welding.—JULIUS SAUER.—The author first sketches briefly the arc-welding processes of Bernados, Slavianoff and Zerener, and then describes machines, using a resistance-welding process, for automobile tires, chains, etc. He gives interesting figures and curves on the energy consumed and the time needed for certain typical welding operations, and finally discusses how the iron masses of the objects which are being welded are affecting the energy consumption and in which manner the welding operation can be carried out most economically in practice.—*Elek. Zeit.*, Oct. 28 and Nov. 4, 1915.

O. H. SIMONDS

Men of the Industry

Changes in Personnel and Position— Biographical Notes

A. W. BERRESFORD

O. H. Simonds, the new president of the Mississippi Electric Association, is the manager of the Vicksburg Light & Traction Company. Mr. Simonds was graduated from Cornell University in 1908, and was connected with the Duluth office of the General Electric Company on construction work, and later with the Great Northern Power Company of Duluth. He then went to the Chicago office of the General Electric Company and made a special study of central-station design and operation, and later entered the engineering department of Messrs. Elston, Clifford & Company, Chicago. In April of this year he was appointed general manager of the Vicksburg Light & Traction Company. While in Vicksburg he has devoted considerable interest to work along local civic lines, and last summer he was elected president of the Young Men's Business Club of Vicksburg.

C. F. Walters has been appointed manager of the Elk River Lighting Company of Elk River, Minn.

Edwin R. Cole has been appointed superintendent of the International Acheson Graphite Company, Niagara Falls, N. Y.

C. S. Terrell, superintendent of substations for the Puget Sound Traction, Light & Power Company, Seattle, Wash., has been elected secretary of the Seattle Section of the American Institute of Electrical Engineers.

Frederick W. Ballard of Cleveland, Ohio, has been engaged by the city of Terre Haute, Ind., to act as the municipality's representative in lighting contract negotiations pending. Mr. Ballard is commissioner and chief engineer of the division of light and heat of the city of Cleveland.

Frank C. Wilkinson, general manager of the St. Albans & Swanton Traction Company of St. Albans, Vt., has been appointed superintendent and general manager of the Vermont Power & Manufacturing Company of St. Albans. Mr. Wilkinson was formerly general manager of the Bay State Street Railway Company, Boston, Mass.

A. Ludlow Kramer has resigned as president of the Electric Properties Corporation. Mr. Kramer recently underwent an operation, and he desires to be freed of business cares in order to recover his health. Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, has been selected temporarily as president.

Charles E. Cooke, Jr., of the firm of Kelly, Cooke & Company, which recently opened engineering offices in the Drexel Building, Philadelphia, Pa., was formerly assistant commercial engineer of the Westinghouse Machine Company at East Pittsburgh, Pa. After occupying this position for two years, Mr. Cooke joined the staff of Ford, Bacon & Davis, and in the latter connection specialized on financial engineering reports and had charge of a number of important rate developments.

Edward N. Lake, formerly in charge of the Chicago office of the Stone & Webster Engineering Corporation, has become a partner in the Krehbiel Company, engineers and constructors, with offices in the Marquette Building, Chicago. Mr. Lake will be treasurer and manager of the company. Fred A. Krehbiel, the president, has specialized in fuel, steam and mechanical engineering and construction. Mr. Lake, who was connected in turn with the Arnold Company, the Western Electric Company, the Chicago Edison Company, and the Board of Supervising Engineers, Chicago Traction, has for the last twenty years made a specialty of electricity and its commercial applications.

Arthur W. Berresford, who was elected president of the Electrical Manufacturers' Club at the time of the latter's recent Hot Springs (Va.) convention, is the vice-president and general manager of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. A native of Brooklyn, N. Y., Mr. Berresford was graduated from the Brooklyn Polytechnic Institute in 1892 and from Cornell in 1893 with the degree of mechanical engineer in electricity. After two years' general work with public service companies, he entered the employ of the Riker Electric Company as designer, and in 1896 took charge of the testing and design work for the Ward Leonard Electric Company. In 1898, in company with others, Mr. Berresford purchased from the receiver the assets of the Iron-Clad Rheostat Company, forming the Iron-Clad Resistance Company, of which he became vice-president and manager. In 1900 this company was purchased by the Cutler-Hammer Manufacturing Company. Mr. Berresford entered the engineering department of the latter and in 1901 was appointed superintendent, in 1902 secretary, in 1905 general manager, and in 1907 vice-president and general manager, the title which he now holds. Mr. Berresford is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the Society of Naval Architects and Marine Engineers, the National Electric Light Association, the Franklin Institute, the Society for the Promotion of Engineering Education, and other bodies.

William F. Kelly, senior member of the engineering firm of Kelly, Cooke & Company, which recently opened general engineering offices in the Drexel Building, Philadelphia, Pa., was for the past fourteen years a member of the staff of Ford, Bacon & Davis, acting as engineer in charge of several of their larger operations, including the construction and reconstruction of the properties of the Knoxville (Tenn.) Railway & Light Company and the Birmingham (Ala.) Railway, Light & Power Company. Mr. Kelly was graduated from the University of Pennsylvania in 1893 and for several years thereafter was a member of the engineering staff of the Union Traction Company of Philadelphia. In its new work Mr. Kelly's firm will conduct a general engineering practice in the public utility and industrial fields.

Obituary

H. A. Fisher, a member of the New York office staff of the Trumbull Electric Manufacturing Company, Plainville, Conn., is dead from an apoplectic stroke suffered while at his desk on Nov. 26. Mr. Fisher has been foreman of the Trumbull company's panel and switchboard department for the past twelve years.

James Mapes Dodge, past-president of the American Society of Mechanical Engineers and chairman of the board of directors of the Link-Belt Company, died at his home in Philadelphia, Dec. 4, at the age of sixty-three years. Educated as an engineer, Mr. Dodge devoted most of his life to the improvement and manufacture of conveying machinery. Mr. Dodge was a vice-president of the Franklin Institute at the time of his death.

New Apparatus and Appliances

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Industry

Varied Industrial Applications of Electrical Ozonators

Ozonators are being used in increasing numbers in industrial plants as adjuncts to ventilating systems for the purpose of destroying obnoxious odors. Ozone is a powerful oxidizing agent and is capable of oxidizing most substances at temperatures much below those at which they are capable of combining with ordinary oxygen. It has been proved to be especially well adapted for use in removing odors arising from various animal and chemical products, such as valerianic acids, butyric acids, skatol, indol, decayed foods, fish, tanners' scrap, manure, etc. Where trade odors are conspicuous and disagreeable, as in tanneries, glue factories, fertilizer plants, slaughter houses, certain chemical works and the like, ozone is said to offer the only solution of the problem of rendering the atmospheric conditions tolerable.

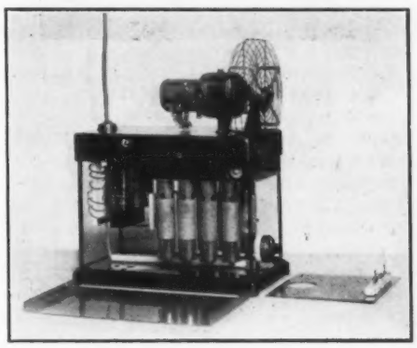


FIG. 1—OZONATOR WITH CASING REMOVED—USED IN COLD-STORAGE ROOMS AND WAREHOUSES

New uses are also continually being found for ozone in manufacturing processes wherever oxidation is desired. For instance, it may be utilized for bleaching cloth, raw wool and flour, and it possesses great advantages over such bleaching products as chlorine owing to the fact that it is not poisonous and does not require to be mixed in vats which suffuse the buildings with fumes. It has also been found well adapted for hardening, purifying and deodorizing paint, oil, varnish and wax, for the special treatment of fur for felting, for the sterilization of beer barrels and vats, for aging liquors, and for curing tobacco. In the purification of water, ozone is employed as an adjunct to the usual systems of filtration. The most general use of ozone for water purification up to the present time has been in connection with the filtration plants of large municipal water-supply systems. Smaller filtration plants utilizing ozone for the final sterilization are now being supplied, however, in sizes adaptable for use in hotels, ice plants, apartment houses and the larger residences.

Ozonators in Cold-Storage Plants and Warehouses

In ordinary ventilating systems only a small percentage of ozone is introduced in the air. In warehouses, packing plants, refrigerators, etc., however, ozone is applied in much larger quantities so as to destroy all bacteria possible. Usually a room or chamber is strongly ozonized for a period of one or two hours each day, thus destroying practically all bacterial life and freeing the room from unpleasant odors during the remaining hours of the day.

An interesting application of ozonators in cold-storage-plant practice has been made by the National Cold Storage Company of Brooklyn, N. Y. In Fig. 2 a portable ozonator is shown in an apple-storage room. The rooms in which the machine is used measure approximately 175 ft. by 100 ft. by 9 ft. and are employed for the storage of such odoriferous produce as onions, cheese, carrots, etc. After a room has been emptied the portable ozonator set is brought in and connected by a cord to a convenient lamp socket. The ozonator is placed in a central position in the room and, with all doors closed, the ozonization is usually accomplished in two or three hours. A somewhat longer period may be required if the room has previously contained foodstuffs of a particularly pungent odor, but even under the most offensive condition of odors the time required for completion of the ozonization is short as compared with the time which would be needed for deodorization by ordinary methods, since in the latter case it is often found necessary to keep the rooms open for two or three

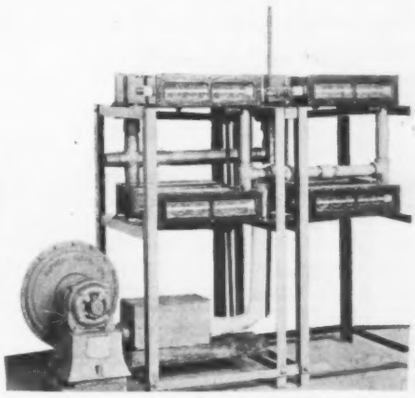


FIG. 3—METHOD OF BOLTING TWO OZONATOR UNITS TOGETHER

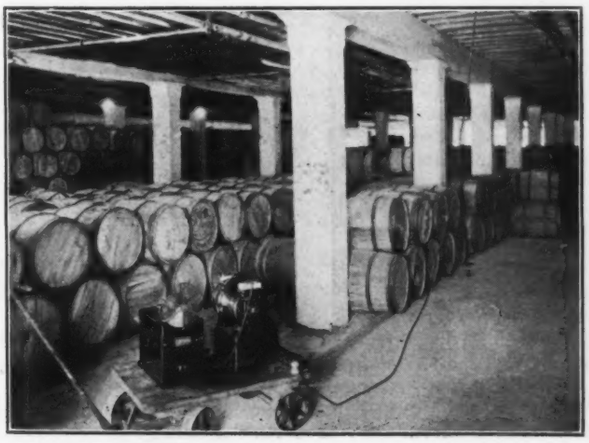


FIG. 2—APPLYING THE OZONATOR TO DEODORIZING STORAGE ROOMS. THE PORTABLE OZONE APPARATUS DESTROYS ODORS LEFT BY FOODSTUFFS THAT HAVE BEEN REMOVED

FIG. 4—DEPARTMENT-STORE BASEMENT IN WHICH OZONIZED AIR DELIVERED THROUGH REGISTERS BENEATH THE COUNTERS IS USED TO NEUTRALIZE ODORS

days, thereby allowing a very considerable rise in the room temperature.

The ozonator is of the 100-volt, sixty-cycle type, energy being taken from a small rotary converter mounted on a truck which converts the 230-volt direct current from the mains. The ozonator

FIG. 5—TWO-UNIT-BANK OZONATOR FOR INDUSTRIAL PURPOSES

consists essentially of ozone-generating tubes contained in a small metal box on the top of which is mounted an electric fan for forcing the air through the ozonator and insuring an efficient distribution of the ozone. The ozone is formed from the air as it is blown through the electric discharge maintained in the ozone-generating tubes. Aside from a monthly cleaning of the ozone tubes the machine requires very little care or attention. Another view of the ozonator with the casing removed is shown in Fig. 1.

Industrial Ozonators

For the practical application of ozone a number of types of industrial ozonators have been developed. In Fig. 5 is illustrated an ozonator of the stationary two-unit-bank type. The essential parts of the equipment are an ozone generator, a transformer, an air filter and a controlling panel. The generating units consist of cast-iron boxes which are provided with ozone-producing tubes. An electric discharge takes place between the inner enameled-steel tube and the outer glass tube. Air is passed through the machine between the inner and outer tubes, where it becomes ozonized, and then is carried through piping to the point of application. Additional units may be added by bolting two or more of the two-unit frames together as shown in Fig. 3. The transformer is employed for raising the voltage at the lines to that required for the proper operation of the ozonators, and it is so designed that the voltage may be varied at will and the ozone output of the generator thereby regulated. The air filter consists of a sheet-steel box through which the air passes before entering the air chamber. In its path through the filter the air first passes over a bed of calcium chloride, and then through a fine screen and a layer of cotton waste for removing dirt and dust. The controlling panel is mounted on one side of the supporting frames and is equipped with voltmeter, switches and suitable apparatus for the regulation of the transformer voltage. A motor-driven blower also usually forms part of the equipment. Motor-generator sets are employed whenever necessary to transform the energy taken from the supply line to such voltage and frequency as is best suited to the particular installation.

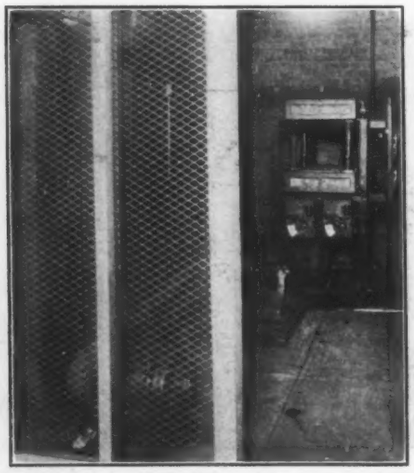


FIG. 6—OZONE-GENERATING APPARATUS USED IN TUNNEL-AIR PURIFICATION

Ozonators in Department Stores

A successful installation of industrial ozonators has been made in the basement of the Lit Brothers department store in Philadelphia. The object of this installation was to eliminate "crowd odors," which are usually present in basement stores and which are especially objectionable on damp and hot days. Before the ozonators were installed ventilation in the basement was provided for by a large blower, the distribution of air being made through registers at the bases of about one-half of the columns in the inclosure, as shown in Fig. 4. The ozone apparatus consists of a two-unit bank ozonator operating on 133-cycle alternating current supplied by a belt-driven generator. The ozonator is placed directly in the fan intake so that the ozone and the fresh air are mixed and distributed through the ventilating ducts.

Ozonators in Candy Factories

As very little fresh air is admitted into the mixing rooms of candy factories, odors are always present, and the use of ozonators has proved a practical solution of the annoyance caused by such odors. For large factories, machines of the industrial type, as shown in Fig. 3 or Fig. 5, are employed in connection with the ventilating systems; but where the plant is small a portable ozonator may be installed directly in the ventilating duct. The Pirika Chocolate Company of Brooklyn, N. Y., has recently installed a portable machine in its chocolate dipping room. In this case the ozonator has been of sufficient capacity for use in a ventilating system supplying a room 40 ft. by 25 ft. by 9 ft. with fifteen changes of air an hour.

Ozone for Purifying Air in Tunnels

The Hudson & Manhattan Railroad Company has installed ozonizing equipment in its tunnels near the Erie Railroad station, Hoboken, for killing sewage odors which seep into the tunnel from a nearby sewer. A 0.5-kw. motor-generator set is utilized to give 133-cycle, 110-volt alternating current to the ozonator, which is designed to give 25 grams of ozone per hour. The air is first passed over a drier, then through the ozonator, and finally is forced into the tunnel by a blower.

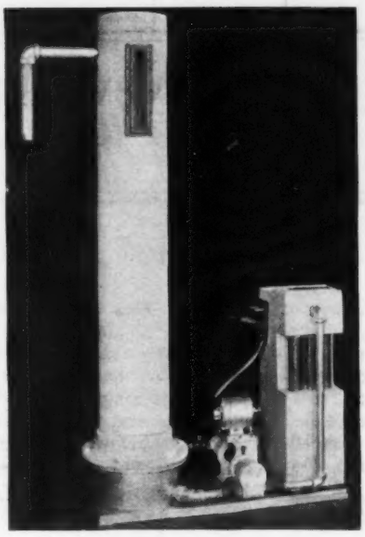


FIG. 7—OZONE-GENERATING APPARATUS FOR PURIFYING WATER

Ozone Water Purifier

A device for properly sterilizing and purifying by ozone the drinking water used in schools, hotels, clubs, hospitals, large apartment houses, restaurants, factories and on steamships and railroads is illustrated in Fig. 7. The purifier operates on 110-volt or 220-volt, sixty-cycle, single-phase current. It has a capacity of 300 gal. per hour and takes about 180 watts.

Advantages claimed for the method of purifying water by ozone are economical operation and that the water leaves the machine at the same temperature at which it enters. The ozone in no way alters the natural character of the water and does not affect the mineral content, it is claimed, but effectually frees it from anything that will give it taste, smell or color of a disagreeable

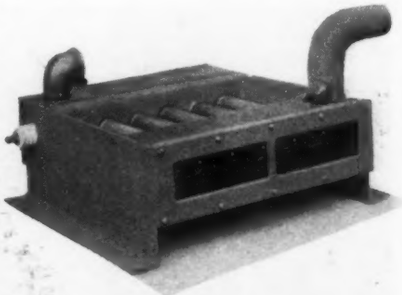


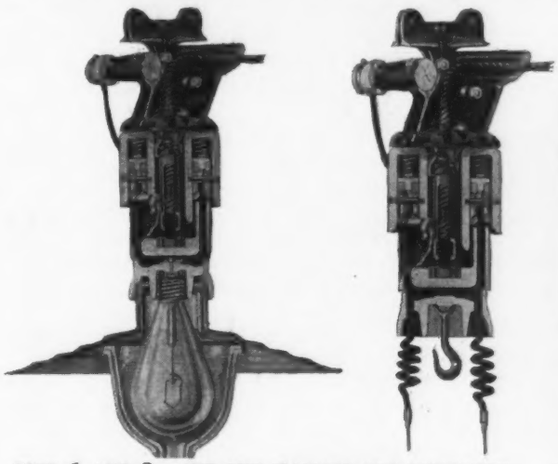
FIG. 8—LABORATORY OZONATOR

organic nature and at the same time renders it sterile.

The ozonators described in this article have been developed by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York.

Automatic Cut-Out Hanger

The "Rex" automatic cut-out hanger, as it is called, is a device which consists of two members, the upper of which may be suspended from a bracket, trolley or span wire, while the lower member, to which an arc lamp or nitrogen-filled lamp may be attached, is removable and when lowered causes the circuit to be broken. By means of this cut-out any lamp in a series lighting circuit may be automatically cut out of the circuit without disturbing any of the other lamps in the series. A cut-out device of this type is especially advantageous to the trimmer, for when the lamp is lowered it is entirely disconnected from the circuit. The wires are brought straight from the pole to the hanger, thus doing away with unsightly loops which may cause trouble for the linemen. The upper member of the cut-out consists of a malleable-iron canopy, which carries the spreader arm to which the line wires are brought and which contains a sheave wheel over which the single rope passes to the second or lower member; a latch plate, which carries a mechanical catch, and a piece of glazed porcelain which contains the electrical mechanism. The lower member is composed of a glazed-porcelain device, which carries two concentric contact rings provided with a safety fuse, and a malleable-iron latch stem to which the rope is attached, and is equipped with a receptacle for taking a Mogul socket, reflector and refractor, or a hook for supporting an arc lamp. The device is being manufactured by Charles E. Pope & Company, 611 New England Building, Cleveland, Ohio.



FIGS. 1 AND 2—CUT-OUT HANGER FOR NITROGEN-FILLED AND ARC LAMPS

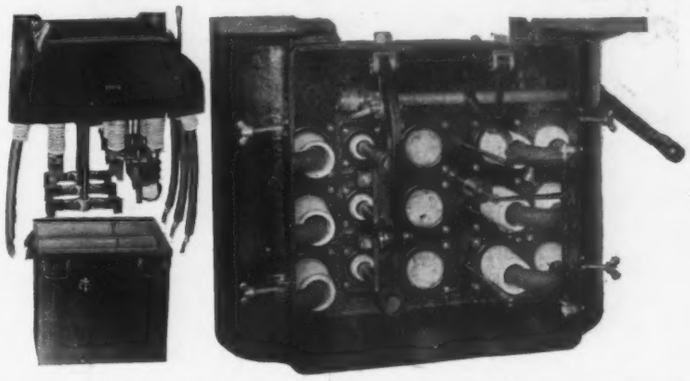
Automatic Pole-Line Oil Switch

The pole-line oil switch shown in the accompanying illustrations has been developed to open automatically the circuit in which the switch is connected if the current in that circuit exceeds a certain definite amount for which the tripping mechanism is set. In many cases the use of this switch in connection with pole-type transformers obviates the necessity of bringing high-tension lines into a building.

The switch is closed by a handle affixed to the frame. The automatic operation on overload is effected by tripping coils in series with the line. These coils are in the oil vessel under oil and are connected to a common tripping lever by separate wooden rods. The tripping device may be actuated by any one of the overload trip coils or by a hand-operated trip rod outside the switch frame. The switch cannot be opened by the closing handle. An inverse-time oil dash-pot connected to the tripping device affords a time delay in automatic tripping.

Insulated cables enter the switch from below through porcelain bushings in an overhang on the switch frame. The space between the cables and the bushings, as well as other bushings through which the cables partly run, is filled with insulating compound. There are no uninsulated parts within the switch frame.

The oil vessel is provided with an insulating lining, wooden barriers between poles and between trip coils, drain cock and filling tap, so that the oil may be changed without lowering the vessel, and handles to assist in handling the switch or in removing the vessel for inspection of the contacts, which are of the sliding-wedge type of construction. With the exception of the operating lever and hand-tripping rod, all parts are inclosed and protected from the weather. The cover is grooved on the under side to fit closely over the edge of the frame. The oil vessel fits around a flange on the bottom of the frame. The switch is being made in single-pole, double-pole, triple-pole or four-pole, single-throw types, for use on circuits with ratings up to 15,000 volts and 300 amp. It is built by the General Electric Company, Schenectady, N. Y.



FIGS. 1 AND 2—SIDE AND TOP VIEWS OF AUTOMATIC OIL SWITCH WITH COVER REMOVED

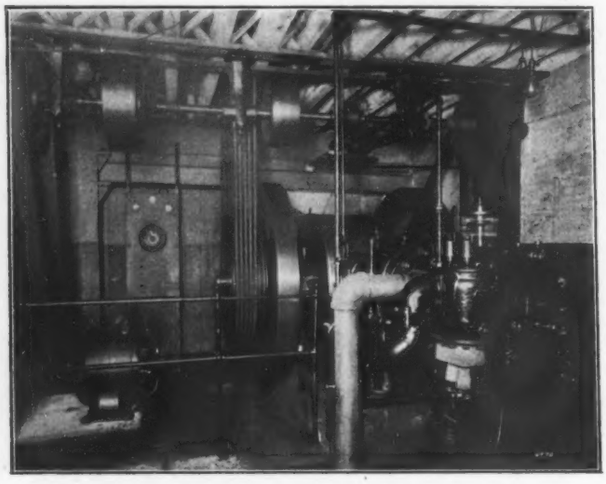
Insulating Tape

The Standard Paint Company, Woolworth Building, New York, has just placed upon the market a rubber friction tape which will be included among its "Imp" products, supplementing the company's P. & B. tape, which is adapted for work in mines and weather-exposed locations. The new friction tape is treated with rubber compound and is suitable for all kinds of wiring work.

Single-Cylinder Horizontal Oil Engine

An oil engine of four-stroke-cycle design, operating on the Beau de Rochas cycle, has recently been developed by the De La Vergne Machine Company, East 138th Street, New York. The engine is massive but well proportioned in design, the prominent features, according to the manufacturer, being simplicity of construction and small number of parts. The frame or bedplate is integral with the cylinder casing and extends almost the entire length of the engine. Oil is injected just before the end of the compression stroke, and the injection is continued until almost the end of the compression stroke. The compression pressure of the engine is about 180 lb. and the ignition pressure slightly above 300 lb. The piston is of the trunk type and of large size. No cross-

head is employed. The cylinder and cylinder head are water-jacketed, and both air and exhaust valves open vertically in the cylinder head. The spray valve is placed at the end of the cylinder head and is directed so that the injected oil will impinge upon the vaporizer at the bottom of the cylinder head. Vapor and air are compressed and mixed in the cylinder head, where igni-



OIL ENGINE IN PAPER-BOX PLANT

tion takes place. Only the gases resulting from the explosion enter the cylinder. The engine is designed to operate on commercial grades of crude or fuel oil produced in the United States or Mexico. Developing 14 brake-hp. per hour per gallon of oil, the engine takes 0.55 lb. oil per brake-hp.-hour at full load, 0.55 lb. of oil per brake-hp.-hour at three-quarters load, and 0.65 lb. oil per brake-hp.-hour at one-half load. The engine is governed by means of a by-pass valve. After leaving the pump the oil may either pass to the spray valve or the check valve in the governor. In the accompanying illustration is shown a type DH engine belt-connected to a line shaft which in turn drives a generator in the plant of a paper-box manufacturer. The shaft is also connected to a rope sheave, as shown, which operates shafting on the various floors of the plant.

Electrically Operated Vertical Steel Radiator

A very desirable substitute for oil and gas stoves, grates and even the ordinary steam radiators is the electrically operated radiator shown herewith, which is far safer and cleaner than the oil or gas stoves. The radiator is of steel and is provided with a complete water-circulating arrangement within itself. It is portable,

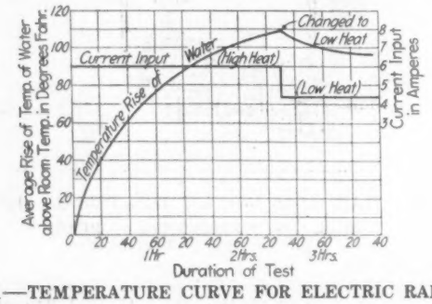


FIG. 1—TEMPERATURE CURVE FOR ELECTRIC RADIATOR

weighing only 65 lb. when filled, and is provided with polished feet so that it can be pushed from one room to another. One filling of water is required before the radiator is put into operation, and it is necessary to add a cupful of water from time to time to keep up the level. Two heats are provided. At full heat the energy consumption on 110 volts is 660 watts, on low heat the consumption at 110 volts is 440 watts. The device may be connected to an ordinary lighting socket and is 18 in. long, 6 in. wide and 24 in. high. The heating surface is 22.5 sq. ft. Another radiator of similar design, desig-

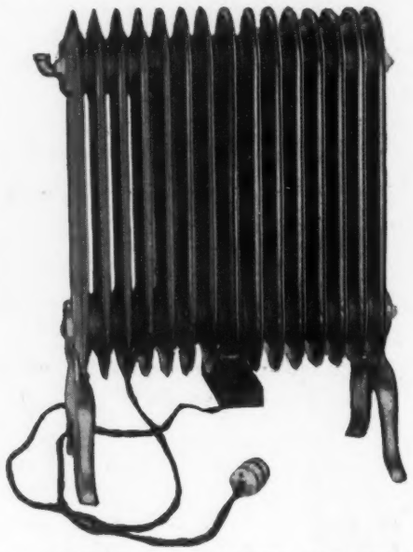


FIG. 2—ELECTRICALLY HEATED RADIATOR WITH FIFTEEN SECTIONS

nated as the No. B-21 type, consisting of twenty-one heating sections and taking 990 watts on high heat and 660 watts on low heat, has also been developed. The radiator is 24 in. long, 6 in. wide, 24 in. high, and has a heating surface of 31.5 sq. ft. The smaller radiator is designed to heat a room 10 ft. by 12 ft. with an 8-ft. ceiling or its equivalent to 70 deg. in winter weather. The larger radiator is designed to heat a proportionately larger area. In Fig. 1 is shown a temperature curve for the smaller radiator with fifteen sections. The radiators are being made by the Rathbone Manufacturing Company, Grand Rapids, Mich.

Electrically Operated Factory Signal Horn

In the accompanying illustrations are shown two recently developed factory signal horns, that illustrated in Fig. 1 being of the vibrator type and operating on

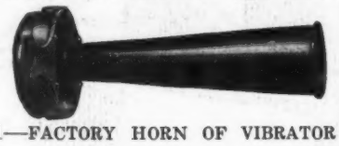


FIG. 1—FACTORY HORN OF VIBRATOR TYPE

either alternating current or direct current, and that shown in Fig. 2 of the motor-driven type operating on direct current. The horns have been approved by the National Board of Underwriters and may be used in

FIG. 2—MOTOR-DRIVEN SIGNAL HORN

connection with interior fire-alarm systems or interior-call systems. A special condenser bridged across the magnet-coil winding is employed with the high-voltage, direct-current vibrator horn to prevent any arcing at the vibrator contacts. The condenser absorbs the charge

or "kick-back" from the coil caused by the breaking of the circuit. The alternating-current horn is equipped with only one moving element. There are no contacts or vibrator springs. It is being made for any commercial voltage from 110 volts down and for any frequency desired. The motor-driven horn is especially well adapted for use with automobiles or in factory service. For use on automobiles the motor is designed for operation on a 6-volt storage battery. The motor is of the skeleton ventilating type and is being made in types designed for operating at potentials ranging from 6 volts to 110 volts. The armature is adjustable so that allowance can be made for wear on the ratchet wheel or diaphragm button. The horns are being made by the Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago, Ill.

Moderate-Voltage Oil Switch for Framework Mounting

The oil switch shown herewith is being built for operation on 300-amp., 35,000-volt circuits and 300-amp., 500-amp. and 800-amp., 15,000-volt or 22,000-volt circuits. It consists of single-pole self-contained units designed for hand or solenoid operation. The switch, which is known as a type F, form K24 device, can be automatically tripped under the usual conditions by instrument current transformers, and under overload conditions by high-voltage series coils mounted on insulators above the switch, or in the 15,000-volt and 22,000-volt sizes by bushing-type current transformers. A calibration of the series-trip mechanism is effected at the switch and not at the coil mounted on the high-voltage insulator. Each bushing transformer is mounted inside the oil tank on an iron support supplied with the transformer. The support is bolted to the under side of the switch cover.

The switch is constructed of interchangeable parts. The bushings are single-piece units extending in the oil vessel downward to the contacts below the oil level.

MODERATE-VOLTAGE OIL SWITCH FOR FRAMEWORK MOUNTING

The oil tanks are lined with pressboard and are of heavy steel, which is acetylene-welded. Use is made of contacts of the usual sliding-wedge construction. The switch opens by gravity assisted by a tension spring. The parting movement of the contacts is rapid when the switch is opened.

Lifters for raising the tank the entire distance between the station floor and the switch frame may be provided if desired. One lifter only is needed for each station. The lifter consists of a simple detachable frame, which carries a handle, worm gear, shaft and two drums for winding and unwinding the drums to raise or lower a tank respectively. The lifter can be operated, removed and replaced on another similar switch by one man.

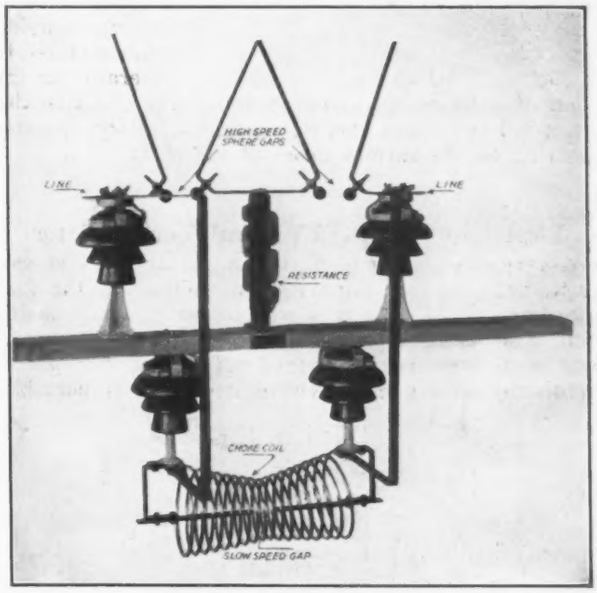
The switch is being manufactured by the General Electric Company, Schenectady, N. Y.

Confining Transmission Disturbances to Their Source

To protect electrical equipment from damage by surges it has usually been the practice to install choke coils or reactors between the outside lines and the equipment and drain off the surge through horn-gaps to ground. This has minimized the possibility of damage to inside apparatus, but it does not insure full protection to line insulators, which are a vital part of a system. The Delta-Star Electric Company, Chicago, however, has developed apparatus which can be inserted in series with conductors at any desired intervals to prevent a disturbance causing extensive damage.

As shown by the accompanying illustration, the equipment consists of two horn-gaps in series with the conductor, but shunted by a choke coil which will allow normal current to pass. The △-shaped horn is grounded through a multiple-series resistance arrester. At the heel of each horn is attached a small metal sphere, and extending from both choke-coil terminals inward are bars, the ends of which are slightly nearer each other than the balls on the horn-gaps.

The action of the equipment is as follows: If a voltage wave with steep front approaches the apparatus the choke coil will check its progress along the line, causing



APPARATUS THAT ACTS AS AN ELECTRICAL SHOCK ABSORBER IN DISSIPATING SURGES

some of the energy to "spill" to ground by allowing it to jump across the sphere-gaps. If the surge is abnormally large, it will break down the gap inside the choke coil and continue along the line until another opportunity is afforded for its escaping to ground. In other words, this apparatus acts as a shock absorber, dissipating all or part of a surge and allowing the re-

mainder to pass on to other absorbers until it is entirely overcome. The net result is to confine a disturbance to a portion of the line, the length of the section which will be disturbed depending on the distance between shock absorbers.

Bell-Ringing Transformers

A line of light transformers for operating bells has recently been brought out by the Viking Electric Company, 150 Chambers Street, New York. The manufacturer points out that the transformers are of high rating and efficiency for the service for which they are designed. In Fig. 1 is shown the type E-W transformer, which gives a secondary voltage of 6 volts. It measures

FIGS. 1, 2 AND 3—TRANSFORMERS FOR RINGING BELLS

3.875 in. by 3.875 in. by 2 in. and weighs 4 lb. The device shown in Fig. 2 is designated as a type A instrument and is designed to give a secondary pressure of 8 volts. It is 4.75 in. by 4.25 in. by 2.625 in. and weighs 6 lb. Both the transformers are designed for operation on 110-volt, sixty-cycle alternating current. The type D transformer shown in Fig. 3 is designed to operate door openers, gas-lighting systems, etc., as well as bells up to and including 4 in. in diameter. It is provided with three secondary terminals. With the first and second terminals a pressure of 8 volts is obtained, with the second and third terminals 14 volts, and with the first and third terminals 22 volts. The device is 4.75 in. by 4.25 in. by 2.625 in. and weighs 6 lb. It is also designed to operate on 110-volt, sixty-cycle alternating current.

Motor for Operating Disk-Type Phonographs

Present owners of phonographs and talking machines of the disk-record type which are operated by cranking a spring motor will be interested in the novel small electric motor brought out to drive such machines by the Shelton Electric Company, 30 East Forty-second Street, New York. The motor, which may be attached to any disk-type machine, is provided with a rubber disk which fits against the periphery of the record table. The motor is not attached to the cabinet, but simply

VERTICAL MOTOR WITH RUBBER DISK FOR PHONOGRAPH

rests on it. The regulator on the phonograph can be employed in the usual way. With the exception of removing the crank handle no change is necessary. The motor is 3.5 in. high and 3 in. in diameter and weighs 3 lb. It is being made for operation on either alternating current or direct current and runs silently.

Side-Outlet Current Tap

To take care of the increasing demand for electric appliances made of heat-proof material, Harvey Hubbell, Inc., has placed on the market a composition side-outlet current tap as shown herewith. The device has been designed especially for use in railroad shops, shipbuilding yards, industrial plants, etc., where devices

COMPOSITION SIDE-OUTLET CURRENT TAP

of the type shown are subject to considerable hard usage. The tap is provided with a deep groove for the attachment of a shade holder. The side-outlet tap is of the T-slot type, permitting interchange with all of the Hubbell company's non-polarized taps.

Loud-Speaking Telephone for Show-Window Demonstrations

To obviate the use of lettered cards and to enable the operator of a window demonstration to get his message "across" to the passer-by on the sidewalk, the Western Electric Company, 463 West Street, New York, has

WINDOW DEMONSTRATIONS EXPLAINED BY LOUD-SPEAKING TELEPHONE EQUIPMENT

developed a loud-speaking telephone equipment which consists of a special transmitter and a pair of loud-speaking receivers and horns. The horns and receivers are connected on both sides of the window, just high enough to be outside the reach of mischievous youngsters, and in series with the transmitter, which is placed inside the window, are wired the battery of six dry cells connected in series and the receivers. As the demonstrator wishes to bring out each point, he simply speaks into the transmitter and his voice is magnified by the receivers and horns and carried to the audience outside. The equipment not only brings the demonstrator and his audience into more intimate contact, but serves as an auxiliary attraction to the display itself.

Million-Dollar Power Plant in Indiana Coal Region.—Work has been started on the new electric plant at Apraw Falls, near Bicknell, Ind., which it is estimated will cost about $1,000,000. Power will be furnished both by steam and by water. The coal supply will come from 2500 acres of coal land near by which have been purchased. The coal is near the surface, making the sinking of shafts unnecessary. Water will be stored by a large dam to be constructed across the White River.

Operating Trouble Diagnosed Over the Telephone.—On starting a 300-kw. rotary converter in a substation one morning the operator was unable to account for a vicious arc at one of the terminals of the shunt-field circuit. The connections were apparently all right. A conversation with the electrical engineer over the telephone resulted in directions to pull the terminal out from the coil and fill the hole behind it with very thick shellac. This was done and the arcing stopped.

Bell Telephone System Spends $1,709,698 for Employees' Benefit.—In the last year there were 20,915 cases on which the relief fund of the Bell Telephone system expended $1,481,402, according to John S. Kennedy, secretary of the benefit committee of the Eastern section of the system. During the same period there were 231 deaths, as a result of which dependent relatives received 228,296. Female employees furnished 71 per cent of the sickness cases, while the greatest number of accident cases occurred among the male employees.

Amount of Electricity Necessary for Heating Rooms.—Electric heating has been seriously tried in a great many places in Norway, and reports made by a royal commission indicate that a pleasant, even temperature is possible with an expenditure of from 30 watts to 35 watts per cubic meter of space—35 cu. ft. This will keep the temperature of a room at 64 deg. Fahr. with auxiliary heating when the thermometer registers as low as from 10 deg. to 5 deg. Fahr. Under these circumstances electric heating is assumed to be cheaper than other fuel when the energy can be supplied at $7 to $8.25 per horsepower per annum on maximum demand.

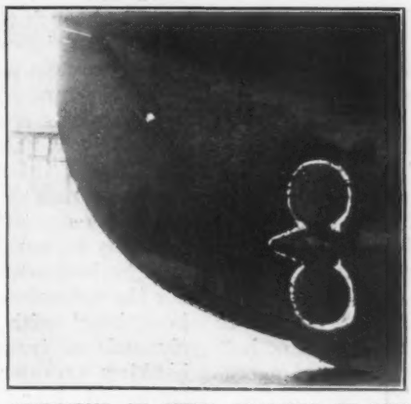
Water Weed Chokes Penstock.—The Mendon station of the Rutland (Vt.) Railway, Light & Power Company recently suffered a peculiar mishap. Water weed in the East Pittsford pond, which supplies the station, floated down to the intake of the penstock, completely stopping it up. The water in the pond was very low, as it was near the end of the season, and the hard wind caused waves which loosened the weed. The latter accumulated in such large quantities that it was necessary for a dozen men to work all day and all night with rakes and pitchforks taking it out of the water. A horse-drawn rake was also used. This was backed down to the beach into the pond, and large quantities of weed were pulled out in this way.

NOTES
ON ELECTRICAL TOPICS

Radio League of America Formed.—The Radio League of America was recently organized under the laws of the State of New York for a number of purposes, principal among which will be to have available for the government a complete list of amateur radio stations pledged to volunteer work in time of need.

A Beetle That Bores Into Lead-Covered Cables.—The discovery of a bug which bores holes in lead-covered cable has been recently reported by Albert Schuler of the Home Telephone Company of Santa Barbara, Cal. This trouble maker is said to be a slender black beetle with hard wings about ¼ in. long and equipped with two small scoops at its mouth which it effectively uses in boring holes in cables. The family name of this beetle is said to be *Sinoxylon declive*.

The Case of the Yacht Sea Call.—The widespread corrosion of the steel rivets, frame and other ferric parts of the splendid new yacht Sea Call resulting from electrolytic action between the steel and the Monel-metal plates with which the vessel was sheathed has made necessary the dismantling of the yacht, which was completed only last summer at a cost of several hundred thousand dollars. The Sea Call was the first vessel ever built to employ Monel-metal plates, which were selected on account of the durability and resistance of this metal to corrosion. When the yacht was launched, however, the steel parts evidently formed negative elements, with the Monel plates as positive electrodes and the sea-water as the electrolyte, and the galvanic action thus set up first manifested itself in the destruction of some steel rivets that had been used in the Monel-metal plates. Fearing that under the action of the bilge water the injury might extend to the inner steel frame, the hull has been hauled out of the water and dismantled. The illustration herewith shows the action of the electrolysis on the steel rib of the rudder frame.



CORROSION OF STEEL FRAMING OF THE RUDDER OF YACHT SEA CALL CAUSED BY ELECTROLYTIC ACTION OF SEA WATER WITH THE VESSEL'S SHEATHING

Department of Commerce Publications.—A complete revision and detailed classification of the names of importers and merchants in Central America and the West Indies is published as a section of a new edition of the World Trade Directory. The lists have been brought up to date and are presented in uniform style, with a finding index. A new feature is the listing, so far as the information could be obtained, of (1) the American and other foreign agents of Central American and West Indian importing firms, and (2) the names of the parent firms of branch houses in Central American and West Indian cities. The publication is a directory of Central American and West Indian buyers for use by exporters and manufacturers in the United States. The department has also issued a catalog of the publications of the Bureau of Foreign and Domestic Commerce.

A 300-Kw. Radio Station for the Society Islands.—The radio station on Tahiti, one of the Society Island group, which is now being built by the French government, will be ready to receive and transmit commercial messages before the close of 1915, according to an announcement by the United States Bureau of Navigation. The temporary station, which is nearing completion, is a 10-kw. installation of the French type and will serve only until the permanent station is built. The latter will be equipped with a 300-kw. generator driven by a 500-hp. gasoline engine and will transmit a wave-length of about 8000 ft. For the permanent station there will be built eight towers, each 325 ft. high, erected in two parallel rows of four towers each. Two antennas will be provided, one for the 2000-ft. wave-length and the other for the 8000-ft. wave. The permanent station is expected to work with San Francisco, Honolulu, Sydney, South America, Cochin-China, and perhaps Martinique and Guadeloupe in the West Indies.

Cost of Developing Norwegian Waterfalls.—A royal commission has collected a great deal of information bearing upon the waterfalls of Norway. Its report fills 267 pages and states the height of falls, whether the fall in question is owned by the municipality, its capacity at low water and after storing the water, whether exploited, and if so, what the rated capacity is, and what is the cost of installation, all told and per horsepower. The cost of installation per horsepower varies to an almost amazing extent. Some small power stations cost as little as from $11 to $15 per horsepower, while another with a rating of 250 hp. costs in the neighborhood of $280 per transmitted horsepower. On the other hand, a 2700-hp. plant costs approximately $32 per horsepower, while seventeen power plants were laid down at approximately $29.50 per horsepower. The Bergen electric station, having a rating at present of 7000 hp., cost $81 per horsepower, while the full exploitation of the available 20,000 hp. will bring the cost down to $39 per horsepower.

News of the Industry

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Civic Federation to Discuss Vital Industrial Questions

The National Civic Federation will hold its sixteenth annual meeting at the New Willard Hotel, Washington, D. C., Jan. 17, 18 and 19, 1916. Among the reports which will be made by special committees will be one giving an analysis of more than 100 profit-sharing plans now in operation in this country, as well as a description of many abandoned ones and the causes of their failures. It will cover different methods employed in industrial enterprises—manufacturing plants, mercantile houses, public service corporations and financial institutions.

A plan will be presented for the organization of a commission to make a study of the question "How far shall government in this country enter into private industry?" This will provide for a review of conditions in Europe, where the government is more and more taking over private industry. The function of the commission will be to determine if this taking over of private enterprises by the government has resulted in such benefit that it will become the permanent policy or one to be tolerated only as a military necessity.

The industrial economics department will make a preliminary report on its survey of the social and industrial changes that have taken place in the United States during the last generation. Many pressing questions relative to labor conditions in the country will be discussed. Among them will be wages, hours of labor, and the physical conditions of the factory compared with those of thirty years ago. The significance to the wage earner, the employer and society as a whole of the widespread adoption of the principle that industry shall bear the burden of industrial accident will be considered, as well as employees' welfare work.

Widening Field for the Electric Vehicle

In an address before the New England Section of the Electric Vehicle Association of America at Boston, Mass., on Nov. 30, S. G. Thompson of the Public Service Electric Company, Newark, N. J., said that only 16 per cent of the possible electric-vehicle business has been secured in five years' campaigning, and that the industry is developing now more rapidly than commercial power business. Sixty per cent of street freight transportation lies within the electric vehicle's field of service. In the past fifteen years the central stations have secured but 22 per cent of the possible power business. The outlook for successful electric retail delivery service is now remarkable. A recent survey of conditions in New Jersey indicated a market for a maximum of 6000 electric vehicles of low price and 4000 of the higher-cost equipment. Existing prejudice arises from experience of ten to fifteen years ago and is being dissipated constantly by modern service. Electric trucks are to-day so well built that a 50 per cent reduction in the cost of electricity for charging or in the cost of battery maintenance would affect the total cost of operation not over 5 per cent.

The speaker referred appreciatively to the investigation of electric-vehicle operating costs undertaken during the past year by the ELECTRICAL WORLD, and called attention to the variation of but 5 or 6 per cent in the daily expense of operating machines of the same capacity, regardless of the class of service involved. Mr. Thompson presented extended data relative to the hill-climbing abilities of electrically propelled fire apparatus, based on recent tests in New Jersey. In general, they showed shorter running time on grades of 18 and 20 per cent than similar gasoline-driven vehicles, even when overloaded as to crews. The speaker said that although the revenue from battery charging is small in this class of work, the advertising value to the central station of electrically operated fire apparatus, selected on the score of its well-nigh absolute reliability, is worth the effort required to secure the installation of electrically driven equipment.

Work of Extending Trade with Central and South America Described

A review of what has been done by the Department of Commerce to push the trade of the United States with Central and South America is presented in a letter from Secretary Redfield to Senator White of Alabama. We quote from the letter in part:

"Under the appropriation of $50,000 'to further promote and develop the commerce of the United States with South and Central America,' fortunately made available for the last fiscal year when the opportunity presented to our manufacturers and likewise the difficulties to be encountered by them were exceptional, it was possible to appoint ten specialists along particular lines, selected in accordance with the most pressing needs of American manufacturers and exporters. These special agents were directed to investigate in the various countries of Central and South America the markets for hardware, machinery and machine tools, electrical appliances, wearing apparel, lumber and furniture, to gather general trade information, and to study transportation, finance and banking, and commercial laws.

"In selecting the subjects for field study regard was had to the industrial needs of the whole country. Some of the investigations, such as those dealing with finance, banking and commercial laws, should form the basis of all efforts to obtain increased trade with Latin America, without respect to particular industry or locality.

"The branch offices of the bureau mentioned have been established in order to make the information received from our field agents accessible to local manufacturers and exporters. Many of the reports are of too highly confidential a character to permit their publication, yet by means of the commercial agents in charge of these offices such information is conveyed judiciously to the business men concerned. Difficulties experienced by exporters can often be cleared away much more satisfactorily by personal interview than by correspondence.

"The last year, while offering unusual opportunities for the extension of trade with Latin America, has also been beset with unusual difficulties. Shifting in the channels of trade, inadequate shipping, unsatisfactory banking arrangements through European capitals—all these and other factors have necessitated a most careful study of trade and financial conditions.

"The interest aroused in Latin-American trade immediately after the outbreak of the European war was in

large part unmindful of these difficulties. There was continual call for information regarding the lines of trade most in demand. Fortunately, the appropriation 'to further promote and develop the commerce of the United States with South and Central America,' permitted the employment of experts in Washington and, accordingly, a division was created for the purpose of collating all trade information in regard to South America, directing the special agents in the field, and giving advice to inquirers. Since February the exports of the United States to South America have been forging ahead of previous records, and for the six months ended August, 1915, amounted to half as much again as for the corresponding months of 1914.

"So much for what the department has been able to do to promote trade with Latin America. The future is still more promising. With its corps of field agents abroad—commercial attachés resident at the principal capitals and special agents investigating specific lines of industry—supplemented by the consular service, the department has means of acquiring the information needed by business men."

Underwriters to Consider Copper-Coated Steel for Electrical Fittings

Owing to the state of the metal market, manufacturers of electrical supplies have petitioned the Underwriters' Laboratories for permission to substitute brass or copper-coated steel for brass or copper in certain parts of electrical fittings. The laboratories have acceded to the request for a hearing on the subject, and all interested are invited to a meeting to be held in the Hotel Biltmore, New York City, on Wednesday, Dec. 15, at 10 a. m. The meeting was originally scheduled for the New York offices of the Underwriters' Laboratories, but the attendance promises to be so large that more commodious quarters were necessary. The Underwriters are anxious to have an expression from manufacturers, contractors, etc., on this matter before final action is taken, and for that reason the invitation is extended to the entire electrical industry.

Section Meetings of the Associated Manufacturers of Electrical Supplies

The meeting of the board of governors of the Associated Manufacturers of Electrical Supplies called for Dec. 2 was, owing to the death of the father of President Sheppard, postponed until Dec. 8, when it took place at the Biltmore Hotel, New York, at 8 o'clock. E. B. Hatch of the Johns-Pratt Company, Hartford, Conn., and L. W. Downes of the D. & W. Fuse Company, Providence, R. I., were added to the board of governors There was a meeting in the afternoon of the manufacturers of insulating materials, which resulted in the formation of a section in the Associated Manufacturers of Electrical Supplies. C. F. Siemon of the Siemon Hard-Rubber Corporation, Bridgeport, Conn., was temporary chairman of the meeting.

The general secretary of the association has, at the request of a number of the members, issued invitations to the manufacturers of switchboards and panelboards to attend a meeting at the Biltmore on Dec. 14, at 10 a. m., to consider the formation of a switchboard and panelboard section in the association. Keen interest is being shown in the organization of this section, and an enthusiastic meeting is anticipated.

Special meetings of the lamp receptacle and socket section, the knife-switch section and the snap-switch section of the Associated Manufacturers of Electrical Supplies have been called by the respective chairmen of the sections for Dec. 14, 1915, at the Biltmore, New York, to consider a special suggestion in connection with the Underwriters' Laboratories, Inc. These meetings have been called for 1, 2 and 4 o'clock respectively on the above date.

New England's Largest Jobber Enthusiastic Over Prosperity Week Results

Speaking to a representative of the ELECTRICAL WORLD, Frank S. Price, president of the Pettingell-Andrews Company, Boston, said that immediate results are being received from the combined publicity of electrical interests on behalf of Prosperity Week. Although Nov. 29 was rainy and the location of the company's establishment is not especially convenient to the retail trade, a larger number of visitors than usual called to inquire about electric appliances and supplies. The company featured a special semi-indirect lighting fixture for Electrical Prosperity Week, and the immediate returns much more than paid for the advertising. The company mailed 3000 letters with return-order blanks, making a special offer of $4.35 retail and $2.35 wholesale for a bowl fixture, and over 200 orders were received on the opening day of the week. Mr. Price said that the business of the company in house-lighting equipment and in appliances is treble that of a year ago, and that dealers and contractors throughout New England manifested great interest in the week's campaign and in the continuing opportunities for holiday sales. "We have certainly 'cashed in' on this campaign," said Mr. Price, "and the results to date have more than paid the cost of membership in the Society for Electrical Development. The outlook for future electrical sales by widespread and well-directed publicity is excellent."

Chicago Council Ignores Smoke-Abatement Report

By unanimous vote on Dec. 6 the City Council of Chicago ignored the electrification and smoke-abatement report of the Chicago Association of Commerce. The order which was passed by the Council placing that body on record as diametrically opposed to the findings of the engineers of the smoke-abatement committee is as follows: "The Council's committee on railway terminals is directed to take up for immediate consideration the subject of electrification of steam railways within the city of Chicago and report to the Council at an early date such ordinances as in its judgment are necessary to bring about the adoption of electricity as a transportation power where steam power is now employed."

Decision in Flexible-Conduit Patent Suit

The United States Circuit Court of Appeals for the First District has handed down a decision in the suit of the National Metal Molding Company, appellant, versus the Tubular Woven Fabric Company, appellee, involving patent No. 652,806, issued to H. G. Osburn for an improvement in flexible non-metallic electrical conduit. The case was on appeal from the District Court of the United States for the District of Rhode Island, and the United States Circuit Court of Appeals has reversed the decree of the District Court, remanding the case to that court for further proceedings.

In the District Court it was held that the patented device was anticipated by the prior art; that, irrespective of this, the structure in question did not involve invention, and that, even if it did, the claims in issue are not infringed by defendant's device. The claims in

issue on this appeal were Nos. 1, 2, 3, 4, 5, 6, 9, 10, 11 and 12. Claim 3 is typical of claims 1 to 6 inclusive, and claim 11 of claims 9 to 12. They read as follows: "3. A conduit consisting of a helix of semi-flexible material and a flexible material interwoven therewith substantially as described." "11. As a new article of manufacture, a helical coil of material having sufficient rigidity of structure to prevent collapsing under the usual conditions of use, and pliable or flexible material interwoven with the convolutions of said helical coil to impart strength to the structure in a longitudinal direction substantially as described."

The higher court did not regard the device in suit as having been anticipated by the Herrick patent granted July 21, 1891 (No. 456,271), which was the only flexible electrical conduit prior to the plaintiff's. The mere fact that a twisted paper fiber had also been previously used for a weft in making a flat fabric intended for roofing, and that its use for this purpose had been disclosed in letters patent granted to Robinson on Sept. 16, 1852 (No. 36,474), does not militate against the plaintiff's right to such weft members, for the conditions of use under which it is employed are not the same. The court held that the plaintiff's device performed a new function, accomplished a beneficial result and involved invention.

The Tubular Woven Fabric Company states that a petition for rehearing will be filed, and proceedings will be taken with a view to bringing the matter to the Supreme Court of the United States.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Executive Committee Meeting, N. E. C. A.—The next meeting of the executive committee of the National Electrical Contractors' Association will be held at Richmond, Va., on Feb. 7 and 8.

Electrical Engineering Society of Columbia University.—At the meeting of the society on Dec. 3 C. H. Bedell of the Electric Boat Company, Groton, Conn., delivered a lecture on "Submarines."

Dallas Electric Club.—A luncheon was held by the Dallas (Tex.) Electric Club at the Oriental Hotel on Dec. 3, at which time H. S. Cooper, consulting engineer, delivered an address on "Electricity in Our Every-Day Life."

Pittsburgh Section, I. E. S.—There will be a meeting of the Pittsburgh (Pa.) Section of the Illuminating Engineering Society in the rooms of the Society of Engineers of Western Pennsylvania in the Oliver Building on Dec. 17, when S. G. Hibben will present a paper on "Design of Illuminating Glassware."

Indianapolis-Lafayette Section, A. I. E. E. — At the meeting of the Indianapolis-Lafayette Section of the American Institute of Electrical Engineers held at Indianapolis on Nov. 26 W. C. Johnson, vice-president of the Waverly Electric Company, spoke on the "Electric Vehicle in the Transfer Business." An exhibition of illumination was given by H. H. Magdsick of the National Electrical Company of Cleveland.

Cleveland Purchasing Agents' Association.—W. H. LeMar of the Westinghouse Electric & Manufacturing Company recently delivered an address before the Cleveland Purchasing Agents' Association at the Chamber of Commerce on the methods of manufacturing electrical devices. Films were used to show the manufacturing processes through which the devices, from various household articles to the largest type of motor, go. Views of the Westinghouse plant were also shown.

U. G. I. Safety Rally.—A safety rally was held on Dec. 9 by the United Gas Improvement Company in Witherspoon Hall, Philadelphia. John Price Jackson, Commissioner of Labor and Industry for the State of Pennsylvania, spoke on what "Being Careful First" means to workmen. Short addresses were made by Messrs. Gartley and Serrill. There were shown a number of new motion pictures on safety-first and first-aid themes in which the scenes were enacted by employees of the company.

New York Section, I. E. S.—The December meeting of the New York Section of the Illuminating Engineering Society was held on Dec. 8 in the auditorium of the Consolidated Gas Company's building. Charles Hodgson of the Brooklyn (N. Y.) Union Gas Company presented a paper on "Outdoor Illumination of Store Fronts," and M. A. Combs of the Consolidated Gas Company read a paper on "Residence Lighting by Gas."

Brooklyn Polytechnic Electrical Engineering Society.—The Electrical Engineering Society of the Polytechnic Institute of Brooklyn will hold its December meeting on the evening of the 16th in the Spicer Library. The speakers at this meeting will be Monroe G. Woolfson of the Electrical Testing Laboratories, whose subject will be "Commercial Tests on Electric Incandescent Lamps," and J. Van Rensselaer Wall of the Interborough Rapid Transit Company, who will speak on "A Comparison of the Operating Characteristics of 4000-kw. and 1500-kw. Rotary Converters."

Philadelphia Company's Section, N. E. L. A.—The Philadelphia Electric Company's Section of the N. E. L. A. announces its 1916 convention contest, the awards in which will be trips to the 1916 N. E. L. A. convention with all expenses paid. One prize trip will be awarded in each departmental branch. The basis in which awards will be made includes recognition of attendance, discussion at meetings, preparation of papers, section activity, and completion of night-school course. Fifty-seven cash prizes, ranging from $1 to $5 each, are also offered for ideas and suggestions of merit in connection with the company's business and four prizes for the best papers prepared for the departmental branches on subjects appropriate to their respective activities.

Institute of Radio Engineers.—Two papers were presented at the Dec. 1 meeting at Columbia University by Fritz Lowenstein, one on "Capacities" and the other on "Radio Transmission Phenomena." The first of these papers dealt with a number of interesting points in connection with the field energy of capacities and corrected certain common errors in connection therewith. The second paper considered the phenomena of radiation from normal antennas and contrasted critically the explanation of these phenomena given by Tesla with those at present in vogue.

C. S. C. E. Program for 1916.—The Canadian Society of Civil Engineers' program for 1916 contains the following interesting addresses on electrical subjects: Jan. 12, "Telephone Transmission Construction and Distribution of Cable Plant," by H. E. Brockwell; Feb. 9, "Application of Synchronous Condensers for Line Regulation," by F. H. Farmer and E. V. Caton; March 8, "A Modern Fire and Police Signal System," by F. A. Cambridge, city electrical engineer of Winnipeg; April 12, "Mercury Arc Under Atmospheric Pressure," by Prof. J. W. Dorsey; May 10, "Public Utility Development," by H. Hartwell of the New York Engineering Corporation.

Winnipeg Jovians Elect Officers.—At a recent meeting of the Jovian League at Winnipeg, Man., the following officers were elected for the ensuing year: President, J. F. S. Madden, district manager of the Canadian General Electric Company, Winnipeg; vice-president, E. H. Smith of the Canadian Westinghouse Company; secretary, W. H. Reynolds of the Eugene F. Phillips Electric Company, Winnipeg; executive committee, H. Long, electrical superintendent Winnipeg Street Railway; A. E. Esling, manufacturers' agent; J. Henry, superintendent of the Fire & Police Signal System; W. G. Vogan, Northern Electric Company. The Jovians give a luncheon every two weeks in the St. Regis Hotel, at which about sixty attend, including city controllers and civil engineers of the Canadian Society of Civil Engineers.

Public Service Commission News

Kansas Commission

The Kansas Utilities Commission has handed down three orders. One authorizes the Parsons Railway & Light Company, the Emporia Railway & Light Company and the Lawrence Railway & Light Company to sell their franchises to the Kansas Electric Utilities Company. Another grants permission to the Kansas Electric Utilities Company, a new corporation, to operate as a common carrier in Kansas. The third authorizes the issuance of $400,000 of capital stock and $1,150,000 in bonds, the sale of which is to provide funds for taking over the three companies mentioned. The capitalization of the new company will be less than the combined capitalization of the three companies which it supplants by $871,000. The order also provides that the valuation fixed at the hearing should not be used in asking any changes in rates, and that the accounts of the three concerns to be operated by the one new company should be kept separately and their affairs managed separately.

Maine Commission

The Public Utilities Commission of Maine has issued an order on the petition of the Turner Light & Power Company for permission to furnish service in the town of Buckfield. The commission orders "that public convenience and necessity require that a public utility other than the Buckfield Water Power & Electric Company—to wit, the Turner Light & Power Company—be permitted to, and that it in fact do, make, generate, sell, distribute and supply electricity for lighting, heating, manufacturing and mechanical purposes in the town of Buckfield; that the Turner Light & Power Company be authorized to furnish electrical service in Buckfield, provided, however, that before it begins to construct any part of its plant, pole lines or other equipment in Buckfield, or to furnish any of its service therein, it shall file with the president or treasurer of the Buckfield Water Power & Electric Company a written proposal to purchase, when it is ready to turn electricity on in any part of the village of Buckfield, all of the latter company's electrical equipment, pole lines, plant and all things used in its electrical department as it existed Nov. 2, 1915, except its water motor, for the sum of $306.83, or for the fair physical value thereof to be determined by arbitrators."

The testimony taken at the public hearing held shows that the Buckfield company was organized primarily as a water company and that the furnishing of water for domestic use in the village constitutes the principal part of its business. The gross revenue from its electric operations was $321.32 for the fiscal year ended June 30, 1915. The electric service rendered by the company was inadequate and unsatisfactory.

New York Commissions

A year's experience with the reduced electricity rates effected by an order of the Public Service Commission, Second District, New York, has caused some confusion on the part of small customers of the Municipal Gas Company of Albany over the "minimum charge" of $9 a year. In cases where less than $9 worth of electricity has been used in the last year the company has been met with a number of objections when bills were presented in July for the balance represented by this difference. The commission has accordingly now made an order which it is hoped will do away with this confusion. In any month in which a customer's bill for electricity is less than 75 cents the company is permitted to send a bill for this monthly minimum under the rates provided. If at the end of the year the company has collected more than $9 and the customer has not used $9 worth of electricity, the company will refund the difference between the amount collected and the nine-dollar minimum. It has also been found that a good deal of trouble is caused by reason of the fact that the year on which this minimum is reckoned ends July 31, while the company's fiscal year ends Dec. 31. The company is therefore authorized to make this year coincide with its fiscal year, beginning on the first of the coming January. Minimum charges for the period between July and January this year will be prorated and considered as $3.75 for the five months.

Illinois Commission

The State Public Utilities Commission of Illinois has just entered an order in the case of the Belleville electric company which provides for the highest valuation yet made by the Illinois Commission on the property of a public service utility for rate-making purposes. The valuation found is $350,000. A few weeks ago the gas property of the same Belleville utility, the St. Clair County Gas & Electric Company, was valuated at $265,000. Total for both gas and electric properties is $615,000.

A perusal of the order indicates that the Illinois commission has taken a stand on a few debatable questions in rate-making procedure. For instance, in estimating depreciation on this electric property the commission finds 4.4 per cent per annum to be equitable and just. In its opinion the commission states regarding depreciation:

"It was argued by the respondent that the reproduction cost new (undepreciated) is a proper and equitable value to be considered for rate-making purposes. The reasons advanced are (1) that reproduction cost is the amount of money which would necessarily be expended by a utility in duplicating its plant, and (2) that, from a consumer's point of view, a well-operated utility is delivering 100 per cent service and is hence in 100 per cent condition, irrespective of actual deterioration of the physical plant. If there is justifiable ground for such an argument, it must be based upon real reasons, and not upon a mere desire of the owners of a property to maintain its paper integrity. The advocates of the theory would hardly admit that any need of actually duplicating the property will ever arise, or, if such need were to arise, that the property would be duplicated in the same identical manner, despite modern efficiency and economy and despite scientific development in the art. The fact must be faced squarely that property does depreciate in value with age, with use, with changes in the art, and with increases in load. A very vital element in the value of equipment lies in the fact that it probably has ahead of it certain years of effectiveness in the operation for which it was intended. As this period of potential operation is increased or decreased, the value of the equipment as a portion of an operating property is correspondingly enhanced or diminished."

As to the question of going value, the commission has argued this much-mooted subject at considerable length and in connection therewith states, in its opinion: "It would appear that claims for 'going value' should be supported by proof of its existence. . . . The respondent herein has recorded no proof of the existence of any 'going value' during early operations. That proof of such 'going value' is essential, the language of the United States Supreme Court is worthy of the most careful thought." The commission goes on: "Although the courts have not stated explicitly what should be included in a consideration of 'going value,' certain exclusions have been passed upon, and 'good will' has been excluded from 'going value.'"

The commission found that the St. Clair County Gas & Electric Company is entitled to a 7¼ per cent per annum rate of return on a fair value of its property. Such a rate of return is approximately equivalent to an 11 per cent rate of return upon a proper stock issue. The commission excluded certain land now held by the St. Clair County Gas & Electric Company to the value of $9,500, and also excluded certain materials and supplies to the value of $6,800 which were to be used for new constructions and extensions.

The rates fixed by the commission for Belleville electric service are a material reduction over the lighting rates now in effect. The new rates for lighting (residential) are to be 10 cents per kw.-hr. (net) for the first 20 kw.-hr. used per month and 7 cents (net) for the consumption in excess of 20 kw.-hr. per month. The commercial lighting rates are to be 10 cents (net) per kw.-hr. for the first 30 kw.-hr. used per month, 7 cents (net) for the next 30 kw.-hr. used per month, and 4 cents (net) for all the consumption in excess of 60 kw.-hr. per month. The old rate was 12 cents per kw.-hr. for the first 50 kw.-hr. The rates for motor service remain practically the same as at present.

In fixing the amount to be set aside for depreciation by the Colchester Farmers' Telephone Company, the Illinois Public Utilities Commission decided that at least 5 per cent of the property value should be deducted for this purpose from the gross revenue annually.

Corporate and Financial

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—The first dividend to be paid by the company since its reorganization in 1913 was declared by the directors Nov. 6 on preferred stock. The dividend amounted to 3 per cent, of which 1.5 per cent was a regular dividend for the quarter ending Dec. 31 and 1.5 per cent was on account of the accumulated back dividend. Payment will be made Jan. 15. The unpaid back dividends up to last Oct. 1 amounted to 14.5 per cent.

American Gas & Electric Company, New York, N. Y.—At a recent meeting of the directors the cash dividend on the common stock was raised from an 8 per cent to a 10 per cent basis. The extra semi-annual dividend of 2 per cent, payable in common stock, remained unchanged. Stockholders have been given the right to subscribe to $1,079,440 of new preferred stock at par and accrued dividends to the extent of 20 per cent of their holdings.

Customers as Stockholders.—A new and vastly important field is now being opened by some of the large public utilities, namely, the field of the stockholding customer. The importance of this field, which is being vigorously developed by the Pacific Gas & Electric Company, the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., and the Northern States Power Company, is manifold. It is a powerful weapon against any attempt at municipal ownership; it creates a better kind of customer—a customer who, because he feels he is now part of the company and because he has a voice in its affairs, forgets his old animosity to lighting companies in general and becomes a booster; it creates a new field for future financing that up to the present has practically been untouched. Because of past practices utilities are still looked upon by part of the public as swindlers, and just before election time many a politician who didn't know the difference between a kilowatt and a generator found that a municipal-ownership platform was an excellent vote-getter. To stop such a situation education is necessary since the public may be just as misinformed as the politician. However, it is hard to educate the public, and the best solution seems stockholding customers. They may not understand all about electricity, but they do know that municipal ownership will stop their quarterly dividends, and they can convince their friends that politics and electricity make a very poor combination. As a booster the stockholding customer is supreme. The greatest asset that a new-business department has is a real bona-fide list of testimonials. When it becomes necessary to provide new capital a large list of customers as stockholders is found extremely valuable. During the first six months of 1915 the Pacific Gas & Electric Company sold $2,279,600 of first preferred 6 per cent cumulative stock to 1214 customers. During the first month of offering stock to its customers the Consolidated Gas, Electric Light & Power Company of Baltimore sold $329,191.50 worth of stock. In the first six months this company has sold to about 1100 customers over 5000 shares, valued roughly at $550,000. The Northern States Power Company has sold to some 350 investors in its territory approximately $200,000 of 7 per cent preferred stock. Stockholding customers will also be valuable to future financing in connection with franchise matters. It is difficult to get money at satisfactory rates if the franchise has but a short time to run or is of an indefinite life. When, however, a large number of customers are holders of stock their position in the community will serve in a large measure to enhance the value of the franchise.

Electric Bond & Share Company, New York, N. Y.—The company has purchased from the Utah Securities Corporation the $3,000,000, par value, outstanding 7 per cent cumulative preferred stock of the Utah Power & Light Company.

Kansas Utilities Company, Lawrence, Kan.—The company is incorporated under the laws of Kansas, having an authorized capital common stock of $1,750,000 and an equal amount of first mortgage 5 per cent ten-year gold bonds. Of the total authorized stock and bonds, there will be issued $1,150,000 of bonds and $400,000 of stock, the approval of the Public Utilities Commission of Kansas having been obtained. The company will take over in fee the properties now owned and operated by the Parsons (Kan.) Railway & Light Company, the Emporia (Kan.) Railway & Light Company and the Lawrence Railway & Light Company. These old companies will be dissolved after their properties have been transferred to the new company. The properties have a valuation, it is stated, far in excess of the stocks and bonds to be issued, and the net earnings derived from the operation of these properties are in excess of two and one-half times interest requirements. Such permanent officers of the new company as have been elected are: Albert Emanuel, Dayton, Ohio, president; Irving Hill, Lawrence, Kan., vice-president; L. A. Pettit, Dayton, Ohio, treasurer. The company will be controlled by the Consolidated Utilities Company, a holding company being organized under the laws of Delaware, and will be operated by the Albert Emanuel Company, public utility operator of Dayton, Ohio.

Northwestern Ohio Light Company, Ottawa, Ohio.—Authority has been granted by the Public Utilities Commission of Ohio to issue $40,000 of common stock and $35,000 of 5 per cent first mortgage, or first and refunding mortgage, forty-year bonds in exchange for a like amount of common stock and bonds of the Electric Light Company of Ottawa, Ohio, being the entire amount of those securities outstanding.

United Gas & Electric Corporation, New York, N. Y.—The directors of the corporation on Dec. 2 declared a dividend of 3 per cent upon the first preferred stock, payable Dec. 30 to stockholders of record Dec. 20. This is the first dividend paid on the company's first preferred stock since April 1, 1914. In response to an inquiry as to the future dividend policy of the corporation, George Bullock, the president, said: "I have every reason to believe that with a continuation of the present prosperity of the company the payment of current dividends from now on will be resumed on our first preferred stock, as the operating results of all the subsidiaries for the past six months have been very gratifying and substantial increases in both gross and net are being shown by practically all the companies."

Manufacturing and Industrial

Electric Motor Trade Swamped with Business

Conditions in the motor market at the present time are such as never before obtained, though they have lasted now for about five or six months. The volume of business far exceeds the first expectations of motor manufacturers. This situation has been brought about, of course, by the exceedingly great amount of war business being handled in this country. War orders mean apparatus and machinery to turn out the vast quantities of material contracted for. Motors are called for in both operations. In the early days of the boom holders of war contracts made a raid on the second-hand market, not because the second-hand motor was necessarily cheaper, but because a second-hand motor could be delivered immediately. Unused factories or factories running at a reduced production were dismantled of the apparatus not in use, which immediately found its way into munition factories. The second-hand market, however, could relieve the strain only momentarily, and the tax on manufacturers' stocks was such that it is now practically impossible for manufacturers to guarantee deliveries. An order for one or two motors may probably receive quick delivery, but an order for six or more, which under normal conditions could be easily filled from stock, will now be held up. Motor stocks that twelve months ago were complete in about twelve sizes, three speeds and three voltages now contain perhaps one, or possibly two, motors. Small sizes are chiefly in demand, with the average running in the neighborhood of 15 hp. There is practically no call at present for large motors.

The majority of manufacturers feel that the present unusual condition will prevail for some time, although some hold that the peak is now reached and that a relapse will follow. As for the dumping of motors on the market after war orders have been completed, the opinion of manufacturers is that this will be done in but few cases and that the effect will not be appreciable. Collections have been good. While credit is still being extended where conditions will warrant it, the accounts must be of the best. It is pointed out that most factories working on war material

have contracts that will keep them busy for two or three years, while in almost every line that is now buying motors the entire output has already been contracted for from ten to twelve months in advance. While some manufacturers are of the opinion that there will be a reduction in prices of motors as soon as this rush is over, others hold the opposite opinion. The latter point out that the prices of materials which obtain at present, and which will be as high, if not higher, when peace is declared, will not only prevent a reduction in prices of motors but will in all probability necessitate a material increase. Copper and steel will be in such demand for the rehabilitation of the devastated portions of Europe that a general increase in the prices of these materials is to be expected. While a large number of direct-current motors are finding a ready market in the tool-manufacturing trade, by far the greater proportion of orders is for alternating-current motors. Although many factories had isolated plants generating direct-current energy, they almost invariably ordered alternating-current apparatus so as to take central-station power.

Philip S. Dodd, formerly with the National Electric Lamp Association, has resigned from the W. P. Gould Company and after Dec. 15 will be connected with the J. Walter Thompson Company, 44 East Twenty-third Street, New York, an advertising concern.

The Aberthaw Construction Company, 27 School Street, Boston, Mass., has moved its offices to larger quarters in the Niles Building at the above-named address. The Aberthaw company is a specialist in concrete for industrial plants, dams and similar construction.

Electric Range Manufacturers' Salesmen to Hold Annual Conference.—The salesmen of the Globe Stove & Range Company, a manufacturer of electrical-cooking equipment, will hold their annual sales conference at the factory headquarters, Kokomo, Ind., during the week beginning Dec. 13.

L. K. Comstock & Company, 30 Church Street, New York, have temporarily closed their Canadian office, which has been in charge of O. H. Linton. Mr. Linton will sail for England the latter end of this month with the Third Overseas Battery, Siege Artillery, which is in command of Major E. G. M. Cape.

The Arthur Jones Electric Company has recently moved from 223 South Clinton Street to 55 East Twenty-eighth Street, Chicago. The company is engaged in the repair of electrical equipment for both gasoline cars and electric vehicles. A storage-battery station is also being maintained by the company.

The Western Electric Company, 463 West Street, New York, has moved its headquarters in Detroit, Mich., from 263 Franklin Street to Kirby and Dequindre Streets. The new building is two stories high and has a frontage of 150 ft. and a depth of 130 ft. It adjoins the Grand Trunk Railroad and is in a section which forms a part of the inner belt railway of Detroit. The total floor space is 50,000 sq. ft., and a yard adjacent to the building has an area of 54,000 sq. ft. for accommodating stocks of cross-arms, clay conduit and poles. The building is equipped with various types of appliances for facilitating the quick handling of merchandise.

Shelton Company's Vibrator Business Good.—During the past year the Shelton Electric Company, 30 East Forty-second Street, New York, has noted a 40 per cent increase in its business, its electric vibrators especially being in great demand. Increasing numbers of these machines are being used by physicians. The number of electric vibrators in private homes is also growing larger. The foreign business of the company has increased 35 per cent, shipments being made to China, Japan, India, South America and Australia. Most of the foreign orders are for vibrators for use in hospitals. At present the company's business in Europe is rather stagnant, owing to war conditions.

Canteen Sign Lamps in Demand.—The Solar Electric Company, 154 West Lake Street, Chicago, Ill., is making various types of canteen-shaped lighting signs which are proving very popular for advertising purposes. The signs are made of white-porcelain glass, and letters and designs are cut in by sand-blasting. They can be painted any color and then are baked. The signs may be hung from brackets or special fixtures, or may be mounted on pedestals. Recently the company received an order for 1000 of these signs from the O'Sullivan Rubber Heel Company. The company has also made 8000 of these signs for the Anheuser-Busch company. Other concerns using large numbers of these signs are the Western Union Telegraph Company and the Mason-Siemen Transportation Company of New York. The signs are well adapted for use in all kinds of national advertising and fraternity advertising, and as warning signs.

Business in Wooden Cross-Arms and Poles Picking Up.—E. G. Chamberlin, president of the Southern Exchange Company, 97 Warren Street, New York, dealer in wooden poles and cross-arms, recently stated to a representative of the ELECTRICAL WORLD that his company's business has gradually been improving, indicating that various public-service companies are working under better conditions. The Southern Exchange Company manufactures poles of Southern white cedar, long-leaf yellow pine, cypress and chestnut, which are round or can be sawed octagonal or square. The demand for octagonal-sawed poles is quite steady from certain large cities which require the public-service companies to install poles with attractive finishes. The limit in height of wooden poles, Mr. Chamberlin stated, is usually from 70 ft. to 75 ft. It is hard to get poles of such height, and the supply is decreasing each year. It takes considerable time, Mr. Chamberlin declared, for his company to prepare poles and cross-arms for delivery unless there are a considerable number of poles and cross-arms of the type desired on hand. Mr. Chamberlin thinks that many companies are making a mistake by not letting their wants become known to the pole manufacturers long enough before delivery is expected.

Record-Breaking Business for Betts & Betts.—Judging from indications thus far, the Betts & Betts Corporation, 256 West Fifty-fifth Street, New York, is expecting the month of December to be a record breaker as far as its business is concerned. The company reports that things have picked up wonderfully since Sept. 1, whereas previously business was more or less spasmodic and, with reference to its flasher business, orders came in for only the smaller mechanisms. During the past three months the demand has increased for larger-sized flashers, indicating that people are spending more money for signs. It is estimated that the company's business has already increased thus far this year 100 per cent over that of last year. The company has also noted very marked effects of Electric Prosperity Week, which has boomed its business. The Betts & Betts Corporation is manufacturing several types of self-winding clocks and program bell-ringing systems, for which several interesting orders have recently been received, among these being the following: A self-winding master clock and fifty-five secondary clocks for the Indiana State Normal School, Muncie, Ind., and a self-winding master clock and fifty secondary clocks for the new Albany (N. Y.) Court of Appeals Building. The company has also received an order from the Trio laundry, Atlanta, Ga., for an outside clock, 15 ft. in diameter, the numerals and hands of which are outlined by incandescent lamps.

NEW YORK METAL MARKET PRICES

	Nov. 30 Selling Prices Bid	Nov. 30 Selling Prices Asked	Dec. 7 Selling Prices Bid	Dec. 7 Selling Prices Asked
	£ s d		£ s d	
London, standard spot*	79 10 0		77 5 0	
Prime Lake	19.75	to 20.00	19.37½	to 19.62½
Electrolytic	19.75	to 20.00	19.37½	to 19.62½
Casting	19.25	to 19.50	18.87½	to 19.12½
Copper wire base	20.87½	to 21.12½†	19.75	to 20.00†
Lead		5.25		5.25
Nickel	45.00	to 50.00†	45.00	to 50.00
Sheet zinc, f.o.b. smelter		22.00†		22.00†
Tin, Straits		39.75†		37.37½†
Aluminum, 98 to 99 per cent	57.00	to 59.00	56.00	to 58.00

OLD METALS

Heavy copper and wire	16.00	to 16.25†	16.00	to 16.25†
Brass, heavy	10.50	to 11.00†	10.75	to 11.00†
Brass, light	9.00	to 9.25†	9.00	to 9.25†
Lead, heavy	4.50	to 4.75†	4.50	to 4.62½†
Zinc, scrap	13.50	to 14.00†	11.00	to 11.50†

COPPER EXPORTS

Total tons to Dec. 7 7,055

†Nominal.

New Incorporations

The Reeseville Power, Heat & Light Company, Reeseville, Wis., has been incorporated with a capital stock of $10,000 by R. J. Buss, Joseph O. Mayers and G. C. Schmidt.

The Lowell Light & Power Company, Lowell, Wis., has been granted a charter with a capital stock of $10,000. The incorporators are George C. Pease, Webster F. Pease and Everett J. Pease.

New Industrial Companies

The Kedzie Fixture Company, Chicago, Ill., has been incorporated by Abraham Slevena, E. Slevena and James L. McAuliff. The company is capitalized at $5,000 and intends to manufacture and install electric and gas fixtures.

The Home Engineering Company, New York, N. Y., has been incorporated by John B. Purcell, Frank H. Parcells and George Tiernan, 64 Wall Street, New York. The company is capitalized at $12,000 and will deal in electrical fixtures, apparatus and appliances, chemical articles, etc.

The Interborough Engineering Company, Brooklyn, N. Y., has been incorporated with a capital stock of $10,000 to do a general plumbing, electric-lighting, heating and engineering business. The incorporators are J. and J. Frankfort, Jr., and H. R. Singer, 1352 Thirty-eighth Street, Brooklyn, N. Y.

The Davis Lynn Storage Battery Manufacturing Company, Lynn, Mass., has been incorporated with a capital stock of $1,000,000 for the purpose of manufacturing storage batteries, dynamos and all kinds of electrical apparatus. C. M. Davis, electrical engineer, will be general manager. The officers are: James J. Phelan, president; Thomas W. Gardiner, vice-president; Henry L. Wood, treasurer, and E. Russell Moulton, clerk.

Trade Publications

Conduit Terminal.—The Gillette-Vibber Company, New London, Conn., is sending out an illustrated leaflet on its conduit terminal.

Fuse Switches.—W. N. Matthews & Brother, St. Louis, Mo., are sending out an illustrated folder which contains information on their fuse switches.

Refillable Fuses.—The Multi-Refillable Fuse Company, 723 Fulton Street, Chicago, Ill., has issued an illustrated booklet entitled "Refillable Fuses and Protecting Material."

The Capital Electric Company, Chicago, Ill., has prepared an illustrated wall hanger which contains information on several types of its electrically operated washing machines.

Motor-Driven Tire Inflator.—The Black & Decker Manufacturing Company, Baltimore, Md., has issued an illustrated folder on its "Electroflater" for pumping automobile tires.

Semi-Indirect Fixtures.—The International Shade Company, Springfield, Mass., has prepared an illustrated folder on its "Iscolite" semi-indirect-lighting unit for nitrogen-filled lamps.

Gyrating Fans.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has prepared an illustrated folder on its pedestal-type and ceiling-type gyrating fans.

X-Ray Apparatus for Dentists.—The Waite & Bartlett Manufacturing Company, 252 West Twenty-ninth Street, New York, has issued an illustrated bulletin which describes its radiographic units.

Electric Washer.—The Lockwood Motor Washer Company, Cleveland, Ohio, is sending out an illustrated folder which describes an electric washer which may be attached to any type of washtub.

Lighting Fixture Insulator.—The Milwaukee Gas & Electric Fixture Company, 1910 Fond du Lac Avenue, Milwaukee, Wis., is sending out an illustrated folder on its lighting-fixture insulator.

Portable Vacuum Cleaner.—The Advance Manufacturing Company, Kalamazoo, Mich., has published an illustrated folder containing information on its portable vacuum cleaner operated by a vertical motor.

Box Panels.—The Starrett Electric Company, 215 West Superior Street, Chicago, Ill., has brought out Bulletin No. 10, which contains information on and illustrations of various types of box panels and accessories.

Cables for Automobiles and Motorboats.—The Standard Underground Cable Company, Pittsburgh, Pa., has prepared Bulletin No. 540-1 on its cables for automobiles, motorboats, motorcycles, aeroplanes and stationary gas engines.

Cooling Towers and Condensers.—The Wheeler Condenser & Engineering Company, Carteret, N. J., has recently published the third edition of its "Steam Turbines for Condenser Work" and its "Psychrometric Tables for Cooling-Tower Work."

Wiring Devices.—The Bryant Electric Company, Bridgeport, Conn., has recently prepared a very attractive large-sized 168-page catalog describing and illustrating a large number of different kinds of wiring devices. The catalog is printed in colors.

Lighting Equipment for Nitrogen-Filled Lamps.—Catalog No. 77, issued by the Macbeth-Evans Glass Company, Pittsburgh, Pa., contains information on its "Monax" glassware for use in connection with "Ajax" pendent fixtures for nitrogen-filled lamps.

Ornamental Semi-Indirect-Lighting and Indirect-Lighting Units.—The Mohrlite Company, Urbana, Ohio, has prepared an attractively illustrated catalog which shows a number of its ornamental types of indirect-lighting and semi-indirect-lighting fixtures.

Electric Curling Iron and Small Motor-Driven Appliances.—The Hamilton-Beach Manufacturing Company, Racine, Wis., has prepared leaflets on its H-B improved electric curling iron, "Cyclone" hot-and-cold-blast hair drier, and types D and F vibrators.

Indirect-Lighting Fixtures.—The Pettingell-Andrews Company, Boston, Mass., is sending out an attractively illustrated booklet on indirect-lighting fixtures, Curtis portable lamps and window and direct-lighting reflectors. The publication also contains information on various installations of National X-ray fixtures in the New England States.

Water Meters as an Aid to Locating and Stopping Waste.—The Harrison Safety Boiler Works, Philadelphia, Pa., have issued a sixty-eight-page booklet entitled "Finding and Stopping Waste in Modern Boiler Rooms." It deals with the use and construction of Cochrane combined feed-water heaters and meters, V-notch flow recorders, and precision meters operating on the volumetric principle.

Standard Sizes of Conduit for Insulation of Wires and Cables.—The National Metal Molding Company, Pittsburgh, Pa., is distributing an attractive wall hanger printed in several colors reproducing in one-half actual size conduit charts adopted and recommended by the National Electrical Contractors' Association, showing sizes of conduit required by the National Electrical Code for carrying various sizes of conductors.

Electric Equipment.—The General Electric Company, Schenectady, N. Y., has issued Bulletin No. 42,206, entitled "Curtis Steam Turbine Generators"; Bulletin No. 44,409, on its ventilated commutating-pole railway motor; Bulletin No. 47,409, on its small-capacity industrial oil switches; Bulletin No. 43,253, on its series luminous-arc lamps of the pendent type, and Bulletin No. 44,001-G, which is a price list of renewal parts and supplies for car equipments, mine locomotives, and railway and mine line material.

Electrical Apparatus.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently published a number of bulletins which are sections of its Catalog 3001, on railway-type switches, field switches, type F oil circuit-breakers, fuse blocks for inclosed fuses, "series Mazda" regulating transformers and control panels, porcelain and glass insulators, pole-line hardware, cross-arms, curve analyzing and recording devices, inverse-time-limit reverse-current relays, and oil-drying and purifying outfits.

New England

BRUNSWICK, ME.—The Public Utilities Commission has granted the Central Maine Pwr. Co., Augusta, permission to purchase the property of the Bath & Brunswick Lt. & Pwr. Co., Brunswick.

CAMBRIDGE, MASS.—Plans for the proposed ornamental lighting system on Cambridge Street are practically completed.

FALL RIVER, MASS. — Extensive changes to the street-lighting system and the installation of a large number of new lamps have been recommended by the aldermanic committee on street lights. The improvements include the erection of about fifty additional arc lamps and a large number of boulevard electric and gas lamps.

HOPKINTON, MASS.—The Water Board has contracted with the Boston & Suburban Electrical Engineering Construction Co. to install automatic electrical pumping apparatus at the pumping station. The contract calls for a new Deane or Holyoke single motor, the automatic control to be of the General Electric or Cutler-Hammer type.

SOUTHWICK, MASS.—The Southwick El. Lt. Co., which was recently granted a franchise and contract for street-lighting in Southwick, has notified the town that it has abandoned the project. The company was unable to make satisfactory arrangements with the Amherst Pwr. Co., Greenfield, for energy to operate the proposed system.

WESTFIELD, MASS.—At a special town meeting held recently the voters authorized an expenditure of $14,000 for extensions to the municipal electric-light plant. Of the proceeds $9,000 will be used for the installation of a new boiler and necessary equipment and $5,000 for the erection of a transmission line, transformers, etc., to supply electricity to the plant of the Westfield Mfg. Co. at Lozierville.

WORCESTER, MASS.—The city of Worcester has signed a contract with the Worcester El. Lt. Co. for lighting the streets of the city for a period of ten years. Compared with previous rates the new contract will save the city about $18,000 per year. The total cost of street-lighting including the ornamental lighting service will be about $156,000 per year.

Middle Atlantic

ALBANY, N. Y.—Bids will be received by the Trustees of Public Buildings, Executive Chamber, Capitol, Albany, until Dec. 22, for furnishing electric fixtures and equipment for the Senate Chamber, State Capitol. Drawings and specifications may be consulted at the Department of Architecture, Room 1224, Woolworth Building, New York, and the Department of Architecture, Capitol, Albany. Drawings and specifications and blank forms of proposals may be obtained at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is State architect.

BINGHAMTON, N. Y.—The capital stock of the Binghamton Lt., Ht. & Pwr. Co. has been increased from $1,000,000 to $2,000,000.

BUFFALO, N. Y.—Options have been taken by the Buffalo General Electric Company on two tracts of land in Tonawanda on the Niagara River, near the Buffalo City limits, on which it proposes to erect a large steam-driven electric generating plant, at a cost of about $2,000,000. The present plans provide for an ultimate output of 600,000 hp. The initial installation will have a generating capacity of 100,000 hp.

CAPE VINCENT, N. Y.—The contract for the construction of the transformer station for the Northern Utilities Inc., Watertown, in Cape Vincent, has been awarded to Leonard J. Gates of this village.

DELEVAN, N. Y.—The Public Service Commission has granted the village of Delevan permission to establish a municipal electric-light plant.

GOWANDA, N. Y.—Franchises have been secured by the Gowanda El. Lt. & Pwr. Co. for extension of its transmission lines in the towns of Perrysburg and Dayton. The company is now erecting a line from Cherry Creek to South Dayton.

GREEN ISLAND (not a post office), N. Y.—The Village Trustees have signed two contracts with the Adirondack El. Pwr. Corpn., Glens Falls, one a five-year contract for furnishing electricity for the municipal electric-lighting system, the other for improvements to the street-lighting system, including the installation of nitrogen-filled lamps and other equipment. A transformer will be installed at the Watervliet station to take care of the local service. The cost to the village of the change in the system is estimated at $4,100.

HOLLAND PATENT, N. Y.—At an election held recently the proposal to install an electric generating plant in the pumping station was carried.

LAKE PLACID, N. Y.—The Public Service Commission has approved franchises that permit the electric-light plant at Lake Placid to be connected with the plant of the Paul Smith El. Lt., Pwr. & Ry. Co., Saranac Lake. An agreement between the village of Lake Placid and the Paul Smith company has been ratified at a special election. It permits the village to erect a transmission line to the town of North Elba, at a cost of $10,000, which will connect with a line of the company from Saranac Lake.

MEDINA, N. Y.—S. A. Cook & Co., Medina, furniture manufacturers, are installing a 570-hp. Allis-Chalmers heavy-duty simple engine, belted to a counter shaft; also an Allis-Chalmers 100-kw., 250-volt direct-current generator and one 150-kva., 2300-volt, three-phase, 25-cycle generator belted to a counter shaft. The company expects to install a 300-kva. generating unit next spring. J. V. Russell is chief engineer

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner water supply, gas and electricity, Room 2342, Municipal Building, New York, N. Y., until Dec. 13 for reserving and furnishing electrical generating capacity, current and equipment for use of the high-pressure fire-service pumping stations for the year 1916. Bids will also be received at the same time and place for furnishing electricity for lighting in the boroughs of Manhattan, Bronx, Queens and Richmond as follows: (1) For furnishing and maintaining electric-lighting units for lighting public streets, parks and places from Jan. 1 to Dec. 31, 1916, both inclusive; (2) for furnishing electric current for lamps and motors in public buildings and for furnishing and maintaining certain equipment during said period; (3) for performing sundry repair and other work to lighting equipment furnished by the city during said period. Blanks, forms of bids, proposals and contract, including specifications, can be secured at Room 2324, Municipal Building, borough of Manhattan.

OSWEGO, N. Y.—The Public Service Commission has granted its approval of the exercise of the franchise granted by the town of Scriba and the construction of a distribution system in that town by the People's Gas & El. Co., Oswego.

PERRY, N. Y.—Preparations are being made by the Perry El. Lt. Co. and the Warsaw Gas & El. Co., which have recently secured franchises for the extension of their lines in the towns of Perry, Warsaw, Gainesville, Castile and Rock Glen, to start work on the erection of the transmission lines at once. Later the Perry company contemplates the construction of another power plant to relieve the two plants in Perry and Warsaw. The purchase of a power site at Glen Rock and Perry is under consideration.

SANBORN, N. Y.—The installation of an electric-light plant in Sanborn is reported to be under consideration.

SILVER CREEK, N. Y.—The Silver Creek El. Co. has applied to the Public Service Commission for permission to issue $150,000 in bonds.

SYRACUSE, N. Y.—The Public Service Commission has approved the franchise of the Syracuse Ltg. Co. for the erection of an additional electric transmission line between Syracuse and Geddes.

TONAWANDA, N. Y.—Plans have been approved by the Common Council for a new street-lighting contract with the Tonawanda Pwr. Co. for a period of three years, which provides for the installation of 50 ornamental lamps in the business district.

CYNWYD, PA.—The installation of about 25 new electric lamps in the section west of Montgomery Avenue has been asked for.

ELLWOOD CITY, PA.—Work on the erection of a transmission line from New Castle to the station of the Pennsylvania Pwr. Co. in Ellwood City will soon be begun by the Mahoning & Shenango Valley El. Co., which took over the local company. The new line was made necessary by the addition to the Shelby Tube Co.'s plant here. Electricity to operate the machinery will be secured from the Pennsylvania Pwr. Co. Energy will be transmitted from the plants of the Mahoning & Shenango Valley El. Co. at New Castle, Pa., and Lowellville, Ohio.

GLENOLDEN, PA.—Preparations are being made by the H. K. Mulford Co. to erect a power house at its plant in Glenolden. Thomas M. Seeds, Jr., 1207 Race Street, Philadelphia, it is understood, is taking sub-bids.

HANCOCK, PA.—Plans are under way for the organization of a company to be known as the Hancock El. Lt., Gas & Pwr. Co. for the purpose of supplying electricity for lamps and motors and to operate a traction system.

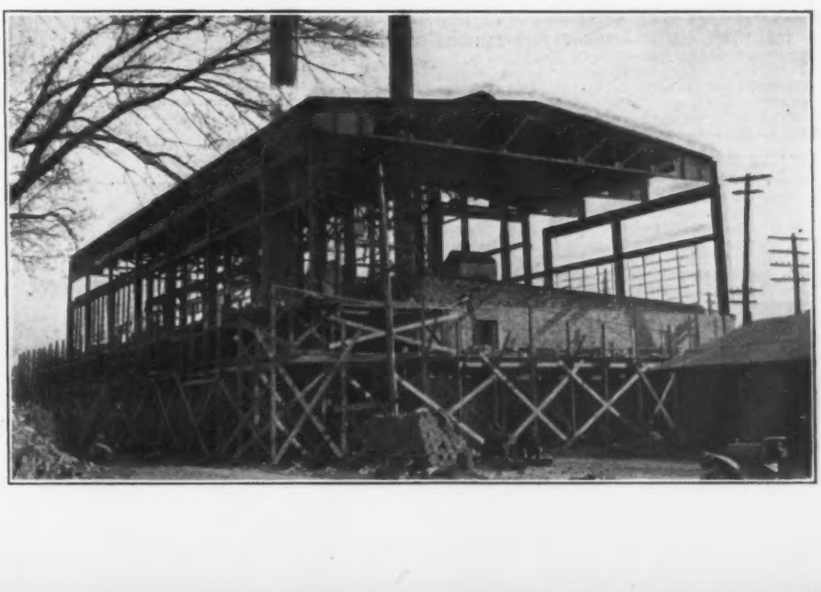
LEWISBURG, PA.—The Citizens' El. Co., Lewisburg, is contemplating removing its overhead wires and placing its wires in underground conduits. Plans have also been completed for the installation of ornamental lamps for two squares on Market Street. They provide for 24 standards carrying three-lamp clusters.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

Building a Modern Plant Around the Old One at Ames, Iowa

The municipal electric-light commission of Ames, Iowa, is building a new power station around and over its present plant, which has been in service for twenty years. Improvements in the equipment have been added from time to time, including a new turbine, and the station building has accordingly become very inadequate, making necessary the construction of the new station. Operation is being maintained during the construction work. The new building will be large enough to admit of the installation of a new battery of boilers while maintaining the present battery in service, preparatory to the relocation of the old boilers and the rearrangement of the engine room. When the work is completed, the city will have a plant of modern proportions and plan, as may be judged from the accompanying illustration.



MEADVILLE, PA.—Plans are being prepared for increasing the output of the municipal electric-light plant. They include the erection of an addition to power house (22 ft. by 70 ft.) and the installation of additional equipment.

OAKMONT, PA.—The Autocar Co., Ardmore, it is reported, is planning to erect a plant in Oakmont. All machinery, it is understood, will be motor-driven. Stearns & Castor, Philadelphia, Pa., are architects.

PHILADELPHIA, PA.—Bids will be received by Robert D. Dripps, director of Department of Public Safety, Room 225, City Hall, Philadelphia, until Dec. 20 for furnishing electric lamps and for lighting, extinguishing, repairing and maintaining such lamps for lighting the streets, avenues, boulevards, sidewalks, alleys, wharfs, parks and public places of the city of Philadelphia from Jan. 1 to Dec. 31, 1916, inclusive. Specifications and proposal forms can be obtained at the office of the Electrical Bureau, Room 616, City Hall.

PITTSBURGH, PA.—The Duquesne Lt. Co., Pittsburgh, has awarded a contract to the Westinghouse El. & Mfg. Co. for two turbo-generators, one having a rating of 40,000 kw. and the other one of 15,000 kw., for its Brunot's Island plant. The cost of the improvements to the plant is estimated at $2,500,000.

RIDGWAY, PA.—Bids will be received at the office of the supervising architect. Treasury Department, Washington, D. C., until Dec. 30 for construction, including mechanical equipment and approaches, of the United States post office at Ridgway, Pa.

SOUTH BETHLEHEM, PA.—The Bethlehem Steel Co., it is reported, has made arrangements with the Lehigh Navigation El. Co. for a large supply of electrical energy from the Hauto plant of the power company. The Bethlehem company, it is said, will bear the cost of the construction of the transmission line.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 9024—miscellaneous convertible steel-plate fans, 24 3-hp. motors for ammunition hoists, four turret-turning motors; Schedule 9046—one water-tube boiler; Schedule 9058—one mechanical steering gear; Schedule 9048—miscellaneous oil-burning range and towing lamps; Schedule 9055—12 radial portable electric drills; Schedule 9078—2000 ft. teephone cable, 240,000 ft. bell wire, 3000 ft. rat-tail wire for aerials, 6500 ft. single-conductor wire; Schedule 9077—25,000 ft. telephone wire. Mare Island, Cal., Schedule 9041—one electrical indicator system. Philadelphia, Pa., Schedule 9025—one ventilating set, 400 cu. ft. capacity; Schedule 9050—100,000 lb. copper ingot. Washington, D. C., Schedule 9061—one electrically driven planer, 72-in. stroke. Newport, R. I., Schedule 9064—2000 ft. single-conductor cable. Applications for proposals should designate the schedule desired by number.

North Central

CLINTON, MICH.—The Village Council has authorized an issue of $5,000 electric-light bonds.

WHITEHALL, MICH.—The capital stock of the Frugale Pwr. Co., Whitehall, has been increased from $20,000 to $100,000. The proceeds will be used for extension and improvements to its plant.

BELPRE, OHIO.—The Village Council is considering the question of granting a franchise to install and operate an electric-lighting plant and water-works system in Belpre.

CANAL DOVER, OHIO.—The Dover, Millersburg & Western Ry. Co., it is reported, is receiving bids for the construction of the proposed railway from Canal Dover to Millersburg via Sugar Creek. A power house, it is understood, will be erected at or near Sugar Creek. The company was recently granted a franchise by the County Commissioners to construct an electric railway in Holmes County to connect Millersburg with Sugar Creek and Canal Dover. Benjamin George is interested in the company.

CANTON, OHIO.—The City Council has authorized Z. W. Kent, director of public service, to contract with the Canton El. Co. for 21 luminous-arc lamps and 52 nitrogen lamps of 25 cp. to be erected on ornamental standards and maintained by underground wires. Poles and wires will be moved from the district covered by this installation, about 1.25 miles.

CLEVELAND, OHIO.—The City Council has authorized an expenditure of $75,000 for extensions of cables of the municipal electric-light plant.

COSHOCTON, OHIO.—The Ohio Ser. Co., which controls the Coshocton Lt. & Htg. Co. has been granted permission by the Public Utility Commission to issue $8.000 in bonds and $12,700 in capital stock, the proceeds to be used for extensions and improvements in Coshocton and neighboring counties and the purchase of the plant of the Strasburg (Ohio) El. Co.

MALVERN, OHIO.—Bids will be received by H. V. Buel, village clerk, Malvern, until, Dec. 18, for lighting the streets and public places by electricity or gas for a period not exceeding ten years. Bids should specify prices for both arc lamps of 450 watts and tungsten lamps of 100, 250, 300, 400 and 500 watts, also type C or nitrogen-filled lamps. Separate bids are also desired for furnishing electricity only for lighting, heating and power purposes.

MASSILLON, OHIO.—Plans are being considered by the Massillon El. & Gas Co. for improvements to its plant on Erie Street, to cost about $100,000.

NORWOOD, OHIO.—Plans are being prepared by the Ault & Wiborg Co., Cincinnati, for the construction of a boiler and power house, 44 ft. by 155 ft., at its plant in Norwood.

PANDORA, OHIO.—The Public Utilities Commission has authorized the Pandora El. Co. to issue $20,000 in capital stock, the proceeds to be used for the purchase of the electric plant and distributing system of D. C. Shank & Co. in Pandora.

STRASBURG, OHIO.—The plant and holdings of the Strasburg El. Co. have been purchased by the Ohio Ser. Co., Coshocton.

URBANA, OHIO.—The County Commissioners have awarded the Urbana Lt. Co. a contract for lighting the county hospital with electricity. The company will erect a transmission line to the hospital and will also wire the building.

ZANESVILLE, OHIO.—Plans are being prepared by C. E. Stevens, consulting engineer, Pittsburgh, Pa., for the installation of an ornamental lighting system on Main, Market and Cross Streets. The plans also include a new lighting system for the "Y," Fifth and Monroe Street bridges. Conduits for the wires have already been laid.

MOUNT OLIVET, KY.—The installation of an electric-lighting system in Mount Olivet is under consideration. Dr. Chandler is reported to be interested in the project.

LAPORTE, IND.—The Public Service Commission has approved a contract between the Laporte Gas & El. Co. and the towns of Wanatah, Lacrosse, Kouts, Union Mills and Wellsboro for furnishing electricity in those places.

MILLER, IND.—The town of Miller has petitioned the Public Service Commission for permission to issue $12,500 in bonds for the construction of a new electric-lighting plant.

SOUTH BEND, IND.—The Public Service Commission has approved a contract between the Indiana & Michigan El. Co., South Bend, and the city of Lakeville for furnishing energy in that city.

WHEATFIELD, IND.—A contract for furnishing service (including electrical service) to the town of Wheatfield by S. W. Hamilton has been approved by the the Public Service Commission.

ALTON, ILL.—Plans are being considered by the Alton & Eastern R. R. Co. for extending its electric line to the site of the new State Hospital for the Insane.

KANKAKEE, ILL.—Plans are being considered by the City Council and the Pub. Ser. Co. of Northern Illinois for the installation of a new street-lighting system in Kankakee. It is proposed to replace the arc lamps in use with tungsten lamps.

MENDON, ILL.—Work has begun on the construction of an electric-light plant in Mendon. James Thompson is reported interested in the project.

MOLINE, ILL.—Work has begun on the excavation for the addition to the power plant of the People's Pwr. Co. at the foot of Fourth Street. Moline, to cost about $10,000.

OAKWOOD, ILL.—The installation of a municipal electric-light plant in Oakwood is reported to be under consideration.

CAMBRIA, WIS.—The Beaver Dam (Wis.) Lt. & Pwr. Co. has applied to the Village Council for a franchise to supply electricity in Cambria

GLENWOOD CITY, WIS.—The properties of the Glenwood & Downing Lt. & Pwr. Co. have been purchased by L. M. Libby, Portland, Ore. Important extensions and improvements are contemplated for the spring of 1916. The company will continue to operate under its present name.

MADISON, WIS.—Plans are being prepared by Arthur Peabody, architect for the University of Wisconsin, Madison, for the installation of an electric fire-alarm system for the group of university buildings. An appropriation of $20,000 is available for the work.

WAUPACA, WIS.—The State Railroad Commission has granted the city of Waupaca and the O. G. Nelson Lumber Co. permission to construct a power dam across the Waupaca River.

BROWN VALLEY, MINN.—The local electric-light plant, it is reported, has been purchased by the Ottertail Pwr. Co., Fergus Falls, at $13,500. Under the terms of the contract the Ottertail company is to erect a transmission line to Brown Valley within 18 months. The lines are also to be extended to Beardsley, Peever and Siseton to furnish electrical service in those places.

CHISHOLM, MINN.—The Shenango Furnace Co. has begun work on the development of a new mine in Chisholm. The machinery throughout will be operated by electricity.

MINNEAPOLIS, MINN.—Plans are being considered by the Nicollet Avenue and Twenty-sixth Street Improvement Association for the installation of ornamental lamps on Nicollet Avenue from Twenty-fourth to Twenty-eighth Street and on Twenty-sixth Street from Stevens to Blaisdell Avenue.

TRACY, MINN.—The municipal electric plant has been purchased by Emil W. Erich of Canby. Mr. Erich was recently granted a franchise to install and operate an electric plant in Tracy.

TRACY, MINN.—Steps have been taken by the Commercial Club to secure the installation of an ornamental lighting system covering five or six blocks in the business section of the town.

WINONA, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 29 for installing conduits and wiring, etc., in the United States post office at Winona. For details see proposal columns.

BARNES CITY, IOWA.—The Oskaloosa (Iowa) Trac. & Lt. Co. has submitted a proposal to the city of Barnes offering to extend its transmission lines to this city and furnish a 24-hour service

CLARINDA, IOWA.—Preparations are being made by the Clarinda El. Lt. Co. to build a new electric plant, at a cost of about $80,000.

DES MOINES, IOWA.—At a special election held recently the proposal to grant the Des Moines City Ry. Co. a new franchise for a period of 25 years was carried. Under the terms of the franchise the company must make improvements to its system involving an expenditure of $1,500,000 within three years, including the construction of 8 miles of extensions and the purchase of 25 new cars.

FAIRBANKS, IOWA.—Bonds to the amount of $6,000 have been voted for the installation of an electric-lighting system in Fairbanks.

CARROLLTON, MO.—The Water, Lt. & Transit Co., Carrollton, is erecting a 13,200-volt transmission line to Bogard and Bosworth.

CARTHAGE, MO.—Plans are being considered by the Home Tel. Co. to change its local plant to the central energy system. The cost of the work is estimated at $50,000.

ST. LOUIS, MO.—The Laclede Gas Lt. Co., St. Louis, has applied to the City Council for a permit to place its high-tension electric wires in underground conduits (covering a distance of 2 miles) from the generating plant at Mount Street and the Levee; also to extend its electrical service to the western and northern sections of the city.

SPRINGFIELD, MO.—A special election will be held Jan 11, 1916, to submit the proposal to issue $400,000 in bonds for the construction of a municipal electric-lighting plant in Springfield.

SPRINGFIELD, MO.—The Springfield Gas & El. Co., it is reported, is contemplating extending its transmission line to supply electricity to the new Frisco mill shop. The cost of the work is estimated at about $8,000.

KILLDEER, N. D.—The Village Board has granted W. E. Kinzell, Mandan, a franchise to install and operate an electric-lighting plant in Killdeer. It is expected to have the plant in operation by Jan. 1, 1916.

MINOT, N. D.—Plans are being considered for extensions to the ornamental street-lighting system next year. It is to cover 25 blocks.

PLAZA, N. D.—The installation of an electric-light plant in Plaza is reported to be under consideration.

WASHBURN, N. D.—The Council has granted Charles G. Arvig a franchise to install and operate an electric-lighting system in Washburn.

REVILLE, S. D.—Plans are being prepared for construction of an electric-light plant in Reville to supply electricity in the towns of Reville, Albee, S. D., and Marietta and Nassau, Minn.

DAWSON, NEB.—Steps have been taken toward the installation of an electric-light plant in Dawson. Energy for operating the system will be supplied by the Humboldt plant.

LINCOLN, NEB.—Bids will be received by H. E. Wells, city clerk, Lincoln, until Dec. 20 for an electric-lighting plant and water-works system at the County Poor Farm.

RUSKIN, NEB.—Bonds to the amount of $6,000 have been voted for the installation of an electric-lighting system in Ruskin.

COFFEYVILLE, KAN.—The City Council has decided to call an election to submit to the voters the proposal to issue $20,000 in bonds for enlarging the municipal electric-lighting plant. The plans provide for the erection of a new building and the installation of additional equipment to double the output of the plant.

DODGE CITY, KAN.—The Midland Wtr., Lt. & Ice Co., Dodge City, contemplates extending its transmission lines to Bucklin and Ford, a distance of 30 miles, to furnish electrical service in those places.

PERRY, KAN.—Bonds to the amount of $5,000 have been voted for the purchase of equipment for the municipal electric-light plant.

RILEY, KAN.—Application has been made to the City Council by R. B. Fegan, representing R. B. Fegan & Co., Junction City, Kan.. for a franchise to install and operate an electric-lighting plant in Riley.

Southern States

GRANITE FALLS, N. C.—The City Council, it is reported, has engaged the Comstock El. Co., High Point, to prepare plans and install an electric-lighting system in Granite Falls.

RALEIGH, N. C.—An agreement has been reached between the City Commissioners and the Carolina Pwr. & Lt. Co., Raleigh, whereby the company will supply electricity for the proposed ornamental lighting system.

ZEBULON, N. C.—The Comstock El. Co., High Point, has been engaged by the city of Zebulon to prepare plans and specifications for the installation of a lighting system in Zebulon.

CHARLESTON, S. C.—At an election to be held Dec. 14 the proposal to purchase the property of the Charleston Lt. & Wtr. Co. for $1.500,000 will be submitted to the voters.

GREENVILLE, S. C.—The City Council, it is reported, has approved the proposal submitted by the Southern Pub. Utilities Co., Greenville, to install an ornamental street-lighting system, consisting of 84 lamps.

HARTSVILLE, S. C.—The Perry-Mann El. Co., Columbia, it is reported, has been awarded a contract to install an electric-generating plant at Coker College.

WEBSTER, FLA.—The granting of a franchise for the installation of an electric-light and cold-storage plant and water-works system is reported to be under consideration by the City Council.

ANNISTON, ALA.—Arrangements have been completed by the property owners on East Tenth Street for extending the ornamental lighting system from Noble to Wilmer.

FLORENCE, ALA.—The Allentown Engineering Co. has been awarded the contract by the Lauderdale Pwr. Co., Florence, to construct a hydroelectric plant. The cost of the work is estimated at $127,558 and will include dam 410 ft. long, with 190-ft. spillway and 42-ft. lift, developing 800 hp. The company will supply electricity for local manufacturing plants.

MOBILE, ALA.—Preliminary plans have been prepared by the Magnolia Compress & Warehouse Co. for the construction of a system of elevated railways or overhead conductors between warehouse properties and water-front. Elevators at each end to permit of lifting of electrically driven tractors or trucks to level of overhead system at one end and lowering of carriers at the other end. The system is to include devices for distribution where needed.

ALTOONA, OKLA.—The installation of an electric-light plant in Altoona is reported to be under consideration.

AUSTIN, TEX.—To make changes in the large dam that was recently built across the Colorado River at Austin and repairs to structure to enable it to develop the electrical energy that was provided for in the original plans, it is estimated, will cost from $75,000 to $100,000. The city of Austin has not yet accepted the dam and hydroelectric plant from the contractors, and there is no early prospect of this being done.

KENEDY, TEX.—The Kenedy Lt. Co. is contemplating installing a 75-kw. generator in its electric-lighting plant.

PORTLAND, TEX.—The citizens have decided to incorporate the town of Portland and to issue bonds for the construction of an electric-light plant.

SAN ANTONIO, TEX.—The contract for the construction of the grade for the first 100 miles of the Houston, Richmond & San Antonio Interurban Ry. Co., San Antonio, which is to run between San Antonio and Houston, will be awarded within the next 60 days. A branch line will be built from Seguin to New Braunfels. The construction of a hydroelectric power plant on the Guadalupe River is also included in the project. E. Kennedy is president of the company.

WINDOM, TEX.—The Texas Lt. & Pwr. Co., Dallas, is contemplating the installation of an electric-lighting system in Windom.

Pacific States

NORTHPORT, WASH.—The Hercules Mining Co., Wallace, Idaho, has placed a contract with the Westinghouse El. & Mfg. Co., Pittsburgh, Pa., for electrical equipment, consisting of motors, switches, etc., amounting to 500 hp., for use in its smelter at Northport.

PORT ANGELES, WASH.—The Olympic Pwr. Co., Port Angeles, which owns and operates an electric plant in Elwha Canyon, 7 miles distant, has been placed in the hands of receivers. H. E. Sims of Port Townsend and C. L. Haggith of Port Angeles have been appointed receivers. The company supplies electricity to the Puget Sound Navy Yard, at Bremerton, Port Angeles and Port Townsend, and has recently closed contracts to supply energy in Sequim and Poulsbo. The Elwha plant has been offered to the city of Seattle at $2,000,000, and its purchase is being considered by the City Council of that city.

SEATTLE, WASH.—The City Council has passed an ordinance authorizing an expenditure of $29,750 for extensions to be made by the city light department during December.

WALLA WALLA, WASH.—The Pacific Pwr. & Lt. Co., Walla Walla, has applied to the Board of County Commissioners for permission to erect an electric transmission line from Prescott to Waitsburg.

ASHLAND, ORE.—Arrangements have been made by the City Council with the California-Oregon Pwr. Co. to take over its local system for a period of three years. Under the terms of the contract the company will furnish electricity to operate the local system.

EUGENE, ORE.—The City Council is considering the installation of an ornamental lighting system on Ninth Avenue.

FORT WINFIELD SCOTT, CAL.—Bids will be received at the office of the quartermaster, Fort Winfield Scott, Cal., until Dec. 23 for telegraph supplies, including telescope brackets, cross-arm braces, cross-arms, porcelain insulators, cedar poles, pole steps, 14,000 ft. No. 6, and 2000 ft. No. 10 solid-conductor wire, and 2000 ft. of guy wire. For further information address John T. Gray, acting quartermaster.

LOCKEFORD, CAL.—Negotiations are under way with the Lockeford lighting district for lighting the town of Lockeford. The initial installation will consist of 30 street lamps of 100 cp.

LOS ANGELES, CAL.—Plans for the construction of a power-distributing system to serve Highland Park and Hollywood and East Hooly district have been submitted to the water board by E. F. Scattergood, chief electrical engineer. The cost of the two systems is estimated at $869,383. It is proposed to purchase the distributing systems of the Pacific Lt. & Pwr. Co. and the Los Angeles Gas & El. Corpn., provided a price can be agreed upon.

PASADENA, CAL.—The City Council is considering the erection of ornamental lamps on West Green Street from Fair Oaks to Pasadena Avenue; also the installation of an ornamental lighting system in the Park Square section.

SAN BERNARDINO, CAL.—A movement has been inaugurated by business men and residents of E and Fourth Streets for the installation of ornamental lamps on E Street from Third to Fifth Street and on Fourth Street from D to F Street.

SAN DIEGO, CAL.—The city of San Diego has contracted with the San Diego Consol. Gas & El. Co. for electrical energy to illuminate a portion of Kensington Park.

KENDRICK, IDAHO.—The contract for all equipment for the initial installation of the power plant to be erected in Kendrick by A. V. Dunkle has been awarded to Thomas & Co., Alaska Building, Seattle. General Electric apparatus will be used.

ST. ANTHONY, IDAHO.—The City Council is considering a proposal to install ornamental lamps on both Bridge and Center Streets from the depot to the M. J. Gray corner.

MIAMI, ARIZ.—At an election to be held Dec. 14 the proposal to issue $40,000 in bonds will be submitted to the voters.

MIAMI, ARIZ.—The State Corporation Commission has authorized the Miami El. & Pwr. Co. to show cause why it should not extend its electrical service to the Live Oak addition.

Canada

EDMONTON, ALTA.—The agreement between the city of Edmonton and the Edmonton Pwr. Co. whereby the latter is given the exclusive privilege to supply hydroelectric power to the city for a period of 30 years has been approved by the ratepayers.

WINNIPEG, MAN.—In order to overcome the trouble caused by breaks in the transmission line to the municipal power plant W. P. Brereton, city engineer, has recommended the installation of two gas engines at the high-pressure plant on James Avenue, to be used to generate electrical energy sufficient to operate two 5,000,000-gal. motor-driven booster pumps at the McPhillips Street pumping station. The cost of this installation is estimated at $21,000, but as the city has equipment worth about $11,000 on hand, the actual outlay would be $10,000. Of this the connecting overhead cable would cost $8,000 and the gas engines the balance.

BERLIN, ONT.—Plans are being considered by the City Council for the installation of an ornamental lighting system on Queen Street.

MUSKOKA FALLS, ONT.—The Ontario Hydro-Electric Power Commission, Toronto, is establishing a hydroelectric plant to develop about 1000 hp. in Muskoka Falls.

PETERBOROUGH, ONT.—The Dickson El. Co., it is reported, has submitted a proposal to the City Council offering to supply electrical energy to the city to the amount of 3000 hp. at $16 per hp., delivered in Peterborough. The City Commission is at present paying $18 per hp. for about 2500 hp.

SUDBURY, ONT.—The purchase of a new transformer and switchboard for the power station has been authorized by the fire, water and light committee.

Mexico

NUEVO LAREDO, TAMAULIPAS, MEX.—General Luis Caballero, Governor of the State of Tamaulipas, with headquarters at Victoria, has appropriated $5,000,000 in Mexican currency (equivalent to about $2,500,000 in United States money), to be used for public improvements, including the construction of a municipal electric light and power plant.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Dec. 22, for furnishing steel angles and I-beams, steel boiler tubes, steel cable, copper wire, steel locomotive pilots, conduits, electric switches, etc. Blanks and general information relating to this circular (No. 995) may be obtained at the above office or the offices of the assistant agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

1,161,837. Switch for Automatic Telephone Systems; W. M. Bruce, Jr., Springfield, Ohio. App. filed Jan. 26, 1912. Selector or connector type.

1,161,840. Electric-Lighting Device; C. E. Campbell, Lynn, Mass. App. filed April 2, 1914. Does away with lead in wires by transformer construction.

1,161,854. Calling Device; O. F. Forsberg, Yonkers, N. Y. App. filed March 9, 1915. Impulse sender for automatic telephones.

1,161,856. Telephone Receiver; S. P. Grace and R. A. L. Snyder, Pittsburgh, Pa. App. filed Oct. 17, 1910. "Loud-speaking."

1,161,863. House Telephone Set; R. R. Ireland, Chicago, Ill., and A. F. F. Gilson, Closter, N. J. App. filed Sept. 18, 1913. Can be installed in ordinary junction box.

1,161,874. Telephone-Exchange System; W. H. Matthies, Antwerp, Belgium. App. filed Nov. 4, 1910. Employs automatic finder switch.

1,161,884. Terminal Bank; J. N. Reynolds, Greenwich, Conn. App. filed May 19, 1913. Bank structure and special brushes.

1,161,890. Permutation Alarm and Circuit-Closer for Sparking Plugs; P. Roussey, Brooklyn, N. Y. App. filed July 21, 1914. For preventing the stealing of automobile.

1,161,909. Telegraphy; P. B. Delany, South Orange, N. J. App. filed Sept. 9, 1910. Automatic; perforated tape.

1,161,932. Automatic Control of Machinery; D. Du Bois, New York, N. Y. App. filed Oct. 10, 1912. Applicable to dynamic braking motors.

1,161,946. Apparatus for Wrapping Pneumatic-Tire Casings; T. Midgley, Hartford, Conn. App. filed Nov. 17, 1906. Wraps muslin about tire or coil of wire.

1,161,989. Insulating Fabric; C. E. Skinner, Wilkinsburg, Pa. App. filed Oct. 7, 1908. Metal foil with hard film of insulation on its surface.

1,161,993. Liquid Rheostat; H. A. Steen, Milwaukee, Wis. App. filed Oct. 23, 1914. Eliminates need for varying liquid level.

1,161,994. Over-Speed Protecting Device for Electric Motors; N. W. Storer, Pittsburgh, Pa. App. filed Nov. 24, 1911. For alternating-current motors having series characteristics.

1,162,007. Substation Message Register; J. A. Wotton, Montclair, N. J. App. filed Oct. 15, 1914. Proof against accidental registration.

1,162,012. Receiver-Supporting Arm; W. R. Armor and L. A. Young, Denver, Col. App. filed Nov. 2, 1914. Releases receiver hook as it swings into position for use.

1,162,031. Electrode Adjusting Means; D. E. Carpenter, Wilkinsburg, Pa. App. filed Feb. 5, 1914. Automatically establishes arc.

1,162,043. Electric Locomotive; G. M. Eaton, Wilkinsburg, Pa. App. filed June 10, 1910. Exceptionally light but strong construction.

1,162,049. Thermo-Electric Generator; E. Garretson and E. W. Schlenker, Buffalo, N. Y. App. filed March 12, 1914. For use in therapeutic instruments.

1,162,069. Telephone System; K. S. Johnson, Jersey City, N. J. App. filed May 10, 1915. Substation circuit.

1,162,071. Automatic Temperature-Controlling System; S. N. Jordan, Lowell, Mass. App. filed Feb. 25, 1915. Thermostatically controlling motor.

1,162,073. Current Interrupter; C. F. Kettering, Dayton, Ohio. App. filed March 12, 1910. For ignition systems.

1,162,076. Electric Switch; C. J. Klein, Milwaukee, Wis. App. filed May 19, 1911. Push-button, garter-spring construction.

1,162,149. Process of Making Wear-Withstanding Coat; E. A. Eckhardt, Philadelphia, Pa. App. filed Oct. 22, 1914. Coats phonograph needle, etc., with tungsten or the like.

1,162,150. Process of Treating Metallic Ores; A. Estelle, Hagen, Germany. App. filed April 6, 1914. Eliminating iron from sulphur compounds of iron.

1,162,159. Message Delivery System; O. W. Hart, Fall River, Mass. App. filed Aug. 28, 1913. For railways. (106 claims.)

1,162,167. Combination Plug and Pilot Light; J. A. Hunt, Pleasanton, Cal. App. filed Feb. 8, 1915. Pilot light mounted within the plug body.

1,162,174. Electromagnetic Regulator; A. Krauss, Cannstatt, Germany. App. filed July 30, 1913. Presses on loosely packed divided resistance material.

Record of Electrical Patents

Notes on United States Patents issued Nov. 30, 1915, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,162,178. Electric Furnace; J. M. Lohr and H. W. Gillett, Ithaca, N. Y. App. filed Aug. 31, 1915. (Dedicated to the public.) Multiple crucible "lift-out."

1,162,179. Electric Furnace; J. M. Lohr and H. W. Gillett, Ithaca, N. Y. App. filed Aug. 31, 1915. (Dedicated to the public.) For melting brass and the like.

1,162,212. Process and Apparatus for Preparing Beverages and Products Produced Thereby; J. E. Bloom, Brooklyn, N. Y. App. filed June 1, 1914. Electrification of wines and grapejuices. (Fifty-five claims.)

1,162,213. Process and Apparatus for the Electrical Treatment of Liquids and Fluids and the Products Resulting Therefrom; J. E. Bloom, Brooklyn, N. Y. App. filed March 31, 1915. Removing colloidal impurities. (Fifty-seven claims.)

1,162,243. Locomotive; W. F. Kiesel, Jr., Altoona, Pa. App. filed Aug. 20, 1914. Cab-supporting arrangement.

1,162,263. Circuit-Closer for Electric Clocks; O. M. Todd, Toppenish, Wash. App. filed April 1, 1915. For controlling the circuits of the secondary clocks.

1,162,267. Apparatus for Recording and Duplicating Music Notes; E. C. Weissmiller, Los Angeles, Cal. App. filed Oct. 20, 1913. Perforating master records for player-pianos.

1,162,287. Flashlight; E. Grah, Toledo, Ohio. App. filed Oct. 22, 1914. Attached direct to binding screw of dry cell.

1,162,288. Lantern; E. Grah, Toledo, Ohio. App. filed Oct. 22, 1914. Lamp frame attached to dry cell.

1,162,341. Composite Metal Body; W. D. Coolidge, Schenectady, N. Y. App. filed Aug. 21, 1912. X-ray target using tungsten.

1,162,354. Connecting Device; H. A. Hart, Hartford, Conn. App. filed April 27, 1915. Plug secured in socket by a partial interrupter.

1,162,355. Electric Lamp; J. O. Hebble and F. H. Humphrevill, Lancaster, Pa. App. filed Nov. 2, 1914. Operated by key.

1,162,361. Electric Switch; P. A. Huddleston, Oklahoma, Okla. App. filed Jan. 23, 1913. For lighting and alarm system.

1,162,363. Electric Heater; H. H. Ingersoll, Chicago, Ill. App. filed April 30, 1915. Applicable to the human body.

1,162,370. Friction Brake; S. H. Keefer, Plainfield, N. J. App. filed March 24, 1910. Brake members are normally not in motion.

1,162,372. Motor; J. C. Kersteter, Minneapolis, Minn. App. filed June 13, 1914. Controls furnace dampers by thermostat.

1,162,405. System of Distribution; E. O. Schweitzer, Chicago, Ill. App. filed Aug. 28, 1914. Feeds loads of different characteristics from power source.

1,162,415. Process of and Apparatus for Producing Ozone; J. Steynis, Bay Shore, N. Y. App. filed Jan. 29, 1913. Air subjected successively to electrical discharges and to cooling.

1,162,419. Motion-Picture Camera; C. Van Deventer, Chicago, Ill. App. filed May 17, 1915. Electrical conductor takes static charge from film.

1,162,437. Device for Protecting Structures from Lightning Strokes; W. Bajohr, St. Louis, Mo. App. filed Feb. 15, 1915. For chimneys.

1,162,447. Electric-Motor Device; W. H. Bristol, Waterbury, Conn. App. filed March 12, 1914. For clocks and the like.

1,162,449. Battery; C. F. Burgess, Madison, Wis. App. filed Dec. 10, 1913. Improved mechanical construction; Le Clanché type.

1,162,458. Electric Regulator; J. L. Creveling, New York, N. Y. App. filed April 16, 1909. For maintaining constant voltage with variable speed.

1,162,459. Electric Regulation; J. L. Creveling, New York, N. Y. App. filed June 11, 1910. Charging storage batteries.

1,162,460. Electric Regulation; J. L. Creveling, New York, N. Y. App. filed Nov. 5, 1910. Storage-battery charging.

1,162,468. Magnetic Apparatus for Railways; A. H. Fox, New York, N. Y. App. filed March 6, 1909. Co-operating electromagnets on roadbed and train.

1,162,469. Circuit-Closer for Hot-Water Heaters; C. A. Fox, Chicago, Ill. App. filed Dec. 8, 1914. Maintains water at constant temperature.

1,162,482. Dynamo-Electric Machine; F. I. Hiss, Jr., Wilkinsburg, Pa. App. filed Dec. 21, 1910. Ventilated field-coil structure.

1,162,483. Dynamo-Electric Machine; F. I. Hiss, Newark, N. J. App. filed Dec. 21, 1910. Field structure with effective radiation.

1,162,493. Rotor for Dynamo-Electric Machines; A. Kingsbury, Pittsburgh, Pa. App. filed July 13, 1910. Substitute for spider construction of usual large machine.

1,162,506. Voltage Regulator for Electric Generators; A. H. Olmsted, Bowdon, England. App. filed Jan. 28, 1913. Varies excitation of generator.

1,162,514. Controlling Apparatus for Electrical Switching Systems; J. N. Reynolds, Greenwich, Conn. App. filed Nov. 4, 1913. Key sets for automatic or semi-automatic telephones.

1,162,516. Electric Time Switch; K. F. Richmond, London, Eng. App. filed Aug. 26, 1914. Two-way tilting switch.

1,162,518. Centrifugal Switch; H. M. Schiebe, Wilkinsburg, Pa. App. filed June 17, 1910. For single-phase fan motors.

1,162,521. Magneto; J. E. Sheriff, Union Hill, N. J. App. filed Nov. 27, 1914. Spark of same density at all speeds.

1,162,537. Compressed-Gas Heater; J. J. Yager, Sheridan, Wyo. App. filed Feb. 2, 1915. For use with carbonating apparatus.

1,162,541. Electrical Switch; J. L. Adams, Jr., Wilkinsburg, Pa. App. filed Nov. 16, 1911. Centrifugally actuated.

1,162,553. Current-Distributing Apparatus; C. N. Bergmann, Pittsburgh, Pa. App. filed Oct. 28, 1910. For panelboards and switchboards.

1,162,556. Automatic Telephone-Exchange System; G. A. Betulander, Södertörns Villastad, and N. G. Palmgren, Stockholm, Sweden. App. filed Dec. 20, 1913. Reduces number of necessary connecting elements.

1,162,571. Contact Device; L. W. Chubb, Edgewood Park, Pa. App. filed Dec. 26, 1913. Anti-vibrating type.

1,162,614. Armored, Flat Electrical Conductor; M. Kallmann (deceased), Charlottenburg, Germany. App. filed Dec. 14, 1911. Resident metal strip with adhesive insulation.

1,162,646. Signal Apparatus; W. K. Porter, Pittsburgh, Pa. App. filed June 3, 1915. Revoluble colored lenses for automobile signaling.

1,162,656. Recording Device; W. W. Salmon and F. L. Dodgson, Rochester, N. Y. App. filed Sept. 28, 1912. Record made where train enters occupied signal section.

1,162,657. Transformer Pole; E. O. Schweitzer, Chicago, Ill. App. filed Jan. 2, 1913. Transformer in base of hollow pole.

1,162,659. Spark-Gap; J. E. Seeley, Los Angeles, Cal. App. filed Nov. 30, 1914. Parallel discharge surfaces.

1,162,655. Electric Switch; A. J. Tizley, New York, N. Y. App. filed April 14, 1915. Candelabra.

1,162,695. Motor for Operating Railway Signals; W. K. Howe, Rochester, N. Y. App. filed July 29, 1911. For semaphore systems.

1,162,699. Device for Indicating Liquid Levels at a Distance; S. Q. Kline, Jr., Washington, D. C. App. filed Nov. 5, 1914. Indicates rise and fall of float.

1,162,719. Water Siren; H. Hecht, Kiel, Germany. App. filed Oct. 26, 1911. Produces note of uniform pitch under water.

1,162,726. Magneto; A. H. Neuland, San Francisco, Cal. App. filed Sept. 3, 1912. For producing both spark and light.

1,162,735. Snap Switch; H. K. Ely, Baltimore, Md. App. filed April 16, 1915. Operated by single push-button.